DOCUMENT RESUME

ED 065 731 VT 016 283

TITLE	Instructional Materials in Manufacturing for Junior High School Industrial Arts. Final Report and Parts I-IV.
INSTITUTION	Ohio State Univ., Columbus.
SPONS AGENCY	Office of Education (DHEW), Washington, D.C.
PUB DATE	67
NOTE	580p.; Report of NDEA Institute for Advanced Study in Industrial Arts (Columbus, Ohio, Summer 1967)
EDRS PRICE	MF-$0.65 HC-$19.74
DESCRIPTORS	Curriculum Guides; *Industrial Arts; Institutes (Training Programs); *Instructional Materials; *Junior High Schools; *Manufacturing; *Program Evaluation
IDENTIFIERS	National Defense Education Act Title XI Institute; NDEA Title XI Institute

ABSTRACT

This Title XI Institute was designed and conducted to introduce the participants to inquiry and invention taking place in industrial arts curriculum across the United States. The institute participated in the inquiry stage through advanced study of manufacturing technology and industrial arts curriculum, and in the invention stage through the development of sample instructional materials based on this advanced study. This document provides an evaluation of the several facets of this institute plus the four volumes of instructional material developed. The sample instructional materials were designed so that participants could place into operation a program that would improve their industrial arts offerings. (GEB)

FILMED FROM BEST AVAILABLE COPY

FINAL TECHNICAL REPORT ON THE
TITLE XI NDEA INSTITUTE FOR: ADVANCED STUDY IN INDUSTRIAL ARTS CODE: 2

AT: THE OHIO STATE UNIVERSITY
(name of institution)

DATES: JUNE 19 (from) AUGUST 11, 1967 (to)

SUBMITTED BY: DR. WILLIS E. RAY
(director)

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION
THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL OFFICE OF EDUCATION POSITION OR POLICY.

VT016283

TABLE OF CONTENTS

Page

LIST OF APPENDICES ii
LIST OF ATTACHMENTS iii
I. INTRODUCTION 1
II. EVALUATION OF INSTITUTE ELEMENTS 2
    USOE - The Ohio State University Program and Fiscal Relations 2
    Pre-Institute Activities 3
        Publicity 3
        Participant Selection 3
        Participant Orientation 4
    Institute Program 5
        Evaluation Scales 5
        Advanced Study 5
        Instructional Materials Development 6
        Participant-Staff Consultation and Communication 8
        Visiting Lecturers 8
        Field Trips 9
        Films 9
        Free and Inexpensive Materials 10
        Graduate Credit 10
    Physical Facilities 11
    Staff 12
    Provision for Follow Up 12
    Major Problems and Solutions 13
III. PROGNOSTICATIONS 16
    Potential Effect on School Programs 16
    Potential Effect on University Programs 17
    Changes That Would Be Made 17
IV. SUMMARY (SPECIAL REPORT) 18

APPENDIX A .... 21 } not available
APPENDIX B 23
APPENDIX C 34
APPENDIX D 50
APPENDIX E .... 57 } not available
APPENDIX F 62
APPENDIX G 64
APPENDIX H 66
APPENDIX I .... 70 not available

LIST OF APPENDICES

		Page
Appendix A	Announcement Brochure	21
Appendix B	Letters to Successful and Unsuccessful Applicants	23
Appendix C	Pre-Institute Orientation Materials Sent to Participants	34
Appendix D	A Summary and Comparison of Participant Ratings of Selected Institute Elements at Mid-Institute and at the Completion of the Institute N = 24	50
Appendix E	Participants' Institute Evaluation Form	57
Appendix F	Statistical Report - Participants	62
Appendix G	Statistical Report - Non-Enrolled Applicants	64
Appendix H	Roster of Participants	66
Appendix I	Miscellaneous Items	70

LIST OF ATTACHMENTS

Attachment A	Generalized Industrial Technology Regardless of Product Part I of IV
Attachment B	Product Synthesis A Part II of IV
Attachment C	Product Synthesis B Part III of IV
Attachment D	Product Synthesis C Part IV of IV

I. INTRODUCTION

Industrial arts, like all other school subject fields, is experiencing change due in part to the current emphasis upon the innovation process in education. This process has been described as having four stages: 1) inquiry, 2) invention, 3) demonstration, and 4) adaptation. There is a need for extended effort on the part of industrial arts personnel to hasten the innovation process in each of its stages.

Because of this need, a Summer NDEA Title XI Institute for Advanced Study in Industrial Arts was designed and conducted at The Ohio State University. Selected participants were introduced to some of the inquiry (research) and invention (development) taking place in industrial arts curriculum across the United States. They participated in the inquiry stage through advanced study of manufacturing technology and industrial arts curriculum. They actively participated in the invention stage through the development of sample instructional materials based on this advanced study. Upon the completion of the Institute, the participants have returned to their school systems to enter into the demonstration and adaptation stages of the innovation process.

This document provides an evaluation of the several facets of this Institute. The primary purposes of this report are to establish the relative success of the Institute in meeting the objectives set for it and to indicate the effectiveness of the general conduct of the program.

II. EVALUATION OF INSTITUTE ELEMENTS

This major section of the report will cover in turn the following elements: 1) USOE - The Ohio State University Program and Fiscal Relations, 2) Pre-Institute Activities, 3) Institute Program, 4) Physical Facilities, 5) Staff, 6) Provision for Follow Up, and 7) Major Problems and Solutions. Evaluative data were collected through periodic seminars, a half-day oral critique and evaluation held on the last day of the Institute, and two administrations of a written evaluation form.

USOE - The Ohio State University Program and Fiscal Relations

The relationships that have existed between the USOE, the administration of The Ohio State University, and the Director of the Institute have been very positive. The early contacts between the Director and the USOE Staff Specialist were conducted easily and freely even under conditions which called for the reduction of budget and number of participants. The informal contacts were most helpful. Formal documents and several amendments were executed promptly and accurately.

The only area of concern relates to the need for the development and application of a consistent set of policies at the University among the several NDEA Institutes held on the campus each year. Questions raised by USOE personnel during the development of the Plan of Operation would have been unnecessary had a more consistent set of policies been applied by the persons responsible for institutes at the University.

Pre-Institute Activities

Activities that occurred prior to the opening of the Institute will be covered under the headings of 1) publicity, 2) participant selection, and 3) participant orientation.

Publicity. Little difficulty was encountered in securing news releases through professional journals and several state association newsletters. Difficulty was encountered in states contiguous to Ohio in securing mailing lists of industrial arts personnel.

An announcement brochure was printed and distributed to over 10,000 addresses through the AIAA mailing list, through the State of Ohio mailing list, to selected teachers in surrounding states, to industrial arts state and city supervisors, and to all persons directly requesting application forms and descriptive literature. Only 380 tear-off application requests were returned as a result of this large mailing. See Appendix A for a display of the announcement brochure.

Participant Selection. Thirteen hundred and ninety-eight (1398) persons requested application forms and descriptive literature. After an initial screening, 1343 mailing packets were sent out. Of this number 488 persons made formal application upon receiving the mailing packet.

A selection panel of four professors in the School of Education at The Ohio State University read and ranked each application. Comparisons were then made in the rankings. This procedure revealed high reliability in the rankings since about one-fifth (approximately 100 persons) were clearly eliminated from further consideration and two-fifths (approximately 200 persons) were clearly "first rank" applicants. Discussions regarding the discrepancies were held and resolved.

Additional criteria were applied to arrive at the designation of 24 selectees and 24 alternates. This final selection was obviously inexact and subject to error because of limited variance on selected attributes. Probably some excellent and worthy persons, better qualified than the ones chosen, were eliminated at this point. Regardless, the performance of the participants during the summer indicated that the selection procedure had been very effective.

Only twelve of the twenty-four selectees accepted the invitation to become participants. Of those rejecting the offer, eleven selected other industrial arts institutes and one chose to attend an educational media institute. This situation provides further evidence that highly qualified persons were selected by the process.

Copies of the letters sent to selectees, alternates, and those not selected are presented in Appendix B.

Participant Orientation. Eight memoranda were forwarded to each participant in several separate mailings between May 11, 1967, and June 6, 1967. Each memorandum covered a significant dimension of pre-institute orientation. Some memoranda required action by the participants and some were information only. These materials are presented in Appendix C.

As a measure of the effectiveness of this procedure, participants were asked to respond to the value of these orientation materials on a mid-institute evaluation form. Twenty of the participants rated these materials as "outstanding" (highest rating) and the other four participants rated the materials as "good" (next highest rating). See Item 2.10 in Appendix D.

Institute Program

This section of the report will present nine subcategories of the Institute program with evaluative statements about each. These subcategories are 1) Evaluation Scales, 2) Advanced Study, 3) Instructional Materials Development, 4) Participant-Staff Consultation and Communication, 5) Visiting Lecturers, 6) Field Trips, 7) Films, 8) Free and Inexpensive Materials, and 9) Graduate Credit.

Evaluation Scales. One major source of evaluation data regarding the effectiveness of the Institute program has been the Participants' Institute Evaluation Form. This form is displayed as Appendix E. This evaluation device was developed by the Institute staff. It is a modification of the questionnaire used by the USOE for Institutes held during the summer of 1966.

The form was administered twice during the eight week period, once at the end of four weeks and again at the conclusion of the Institute. A summary and comparison of the responses for each administration is provided in Appendix D. This device was exceptionally helpful at the end of the first four weeks. Minor "mid-course" corrections were made by the Institute staff based upon the ratings and the responses to the open-ended section of the instrument.

Advanced Study. Two elements of the program were designed to provide advanced learning experiences for the participants. These were: advanced substantive study of manufacturing management, personnel, and production technology and 2) advanced industrial arts curriculum.

The substantive study of manufacturing was enthusiastically received by the participants and in the final rating received mostly "outstanding" and "good" responses (see especially Items 1.1 and 5.1 in Appendix D). Of special significance was the study of production planning and numerical control of machine tools and drafting equipment.

The advanced study of industrial arts curriculum was designed to introduce the participants to several alternative curriculum structures in industrial arts and to provide them with a rationale and structure for internally consistent curriculum development. The success of this phase of the Institute program as rated by the participants appears in Appendix D, especially Items 1.2, 1.3, 5.2, and 5.3. These ratings indicate that this advanced study was effective, successful, and well received by the participants.

Instructional Materials Development. All of the activity of the Institute was integrated by the Development Workshop. Based upon their advanced study, lectures, field trips, films, and industrial literature, the participants developed sample instructional units in manufacturing for junior high school pupils. The products of this effort are presented as Attachments A though D to this report.

In any new departure in curriculum development, there is usually some resistance to change on the part of teachers and supervisors in the field. However, the participants of this Institute quickly recognized the need for change and grasped the general nature of the needed structure for curriculum development in manufacturing for industrial arts. They enthusiastically developed materials individually and in groups. There were periods of time where indecision was evident and direction was given to complete the task of development. The success of this portion of the Institute program is reflected by participant ratings as shown in Appendix D, Items 1.2, 2.4, 3.3, 4.3, and 5.4.

In general, this portion of the Institute was moderately successful as rated by the participants. As indicated in Item 5.4 in Appendix D, one-fourth of the participants thought that the Development Workshop provided the highest realization of the goal set for it, about one-half of the participants checked the next to the highest category, but about one-fourth of the participants had some reservation regarding the realization of the objective. If the criterion applied for success were to be the type and quality of sample instructional materials developed, it must be rated very successful, at least in the opinion of the Institute staff.

The major criticism given by the participants of the Development Workshop related to the process of arriving at the format of style for writing. The staff approached this aspect of the work with the thought in mind that the participants ought to conceive of and prepare the format of style for writing. The participants felt that too much time was spent on this process and would have preferred that a format of style be given to them in the beginning. This is reflected in Item 2.4 of Appendix D. Perhaps this attitude was typical of the participants, since they were very pleased about and did not question the substantive outline of manufacturing technology provided them. They wrote to this substantive outline without any hesitation during the Development Workshop.

One outstanding feature of the Development Workshop involved instruction in the application of readability scales. Because of this effort, the participants became more aware of techniques of writing for the junior high school pupil.

Participant-Staff Consultation and Communication. The Director of the Institute held periodic seminars with the participants for the purpose of group communication. At mid-institute, twenty-two participants felt that the proper amount of time was being spent on this activity with two participants reporting too little time being devoted to seminars (see Item 4.4 in Appendix D). During the last half of the Institute five participants felt that more time was spent in seminars than was needed while nineteen participants indicated that the time spent was about right (see Item 4.4, Appendix D).

In addition to seminars, a large portion of time was spent with individuals and groups regarding class work, instructional materials development, and career plans. In general, this time was well spent, appreciated by the participants, and very effective.

At the conclusion of the Institute, it was felt by the staff that more staff meeting time could have been scheduled. This would have provided for more common direction for participants in their development of instructional materials.

Visiting Lecturers. Three of the five visiting lecturers were outstanding in their presentations. The other two did not meet the high expectations of the staff or participants (see Appendix D, Item 2.3). With regard to the amount of time spent with guest lecturers, the participants concluded that this time was about right (see Appendix D, Item 4.6).

Two of the best presentations (based upon feedback from the seminars) were made during the last four weeks. Yet from a study of the comparison of the two rating periods, it can be seen that the lower rating (Item 2.3, Appendix D) was given at the end of the Institute. The Director believes this reflects some of the comments made by him in a seminar during the last week regarding the relative contributions of the guest lecturers.

Field Trips. Four full-day field trips were taken to a variety of industrial establishments. In two instances the participants were away from the campus for twelve hours and traveled approximately 250 miles by bus each day. The general reaction of the group, as determined during the final oral evaluation and critique, was that they would have preferred to have taken about eight half-day trips to industry in the immediate locality. The participants thought the choice of industries was "good" to "outstanding", and that the total amount of time expended on such trips, in relation to other activities, was about right. For additional data, see Appendix D, Items 2.5, 2.6, and 4.5.

Films. Periodically films were shown covering industrial processes that either reinforced or supplemented the study of manufacturing and the industrial field trips. Film lists covering several fields of manufacturing were duplicated and distributed.

In general, this activity was very well received. Because of the quality of the participants' background, some of the teachers had used some of the films in their own teaching. In one instance a poor substitute film was provided by the distributor. The participant ratings ranged from "fair" to "outstanding" as shown by Item 2.7 in Appendix D.

Free and Inexpensive Materials. Letters were sent to approximately 300 industries and industrial associations in the manufacturing field requesting literature or other materials that could be secured in quantity for school use. The response was excellent. Weekly bulletin board displays were developed to highlight such materials. Lists of sources and types of materials were distributed when the materials were made available. In general, this activity was received with great enthusiasm, and it was rated as "good" to "outstanding" in most cases by the participants. For additional data, see Items 2.8, 2.9, 4.2, and 5.5 in Appendix D.

Graduate Credit. The option was provided to participants to earn graduate credit if they wished (see Memorandum #2, Appendix C). Twenty-three of the twenty-four men requested graduate credit and applied for admission to the Graduate School before they arrived for the Institute. The last man, after learning the plans of the other participants, also requested entrance to the Graduate School and earned graduate credit.

Although it is recognized that grades (marks) and grading at the graduate level are relative to many factors, some indication of participant success can be found in a study of the distribution of marks earned. Each participant was given five marks. Approximately two-thirds of all marks given were A's, approximately one-third B's, and only two C's were recorded out of the 120 marks (24 participants X 5 marks each). This performance is slightly above the normal grading pattern of the institution at the graduate level. Because of these data, it may be stated that the participants were a select group with above average motivation and purpose.

Physical Facilities

In general, it can be said that the participants considered the classrooms, laboratories, and library facilities to be "good" to "outstanding". The living accommodations were likewise rated. Formal Institute activities were held in two adjacent buildings. The dormitory and food service facilities were within two short blocks of these buildings.

Thirteen of the twenty-four participants attended without families and lived in a dormitory. The remaining eleven men brought their families, and, in the main, secured excellent living quarters. Two natural social subgroups developed from this situation. The rating given by participants regarding their living accommodations may be seen in Item 2.7 in Appendix D.

The great majority of the work time of the participants was spent in a newly constructed air-conditioned building. Ratings regarding the various features of this space are given in Items 3.1, 3.2, 3.3, and 3.4 in Appendix D. Although it was not considered a serious drawback by the Institute staff, the consensus was that it would have been better to have held all Institute activities in one building.

Staff

In the estimation of the Director, the work of the senior members of the Institute faculty was excellent. Each provided significant leadership and direction. Dr. Arthur W. Earl, full time visiting professor from New Jersey, was able to step in and make a major contribution. One faculty member, Dr. Donald G. Lux, served the Institute on a half time basis. His contributions were exceptional. However, it would have been better for him to have served full time. The participants indicated that they wished he were available on a full time basis for additional counsel and direction, especially during the last half of the Institute. Dr. Donald R. Kibbey, the manufacturing specialist, provided a breadth and depth of understanding not available in the background of the typical industrial arts teacher educator.

The junior staff, doctoral students in industrial arts, made important contributions to the total effort. One provided administrative assistance to the Director. The others assisted the senior staff in instruction and materials development.

No attempt was made to secure individual faculty ratings. An overall estimate of the quality of the faculty contribution as rated by the participants is shown in Item 2.2, Appendix D. These ratings indicate that, in general, the faculty was considered "good" to "outstanding".

Provision for Follow Up

Each participant has agreed to correspond with the Director regarding the degree of success experienced during the coming school year in the use of ideas and teaching-learning materials. Such communication will be continued as long as it appears useful.

Plans have been made to share professional and personal items through the use of a newsletter. This will be continued as long as it is deemed profitable by the Director and the participants.

Major Problems and Solutions

The term "major" is a relative term. In many respects, it can be said that no "major" problems were experienced. However, some problems did arise and these will be briefly reviewed.

In the initial institute proposal, it was indicated that there would be arranged a special substantive course in production management. However, between the time of the proposal preparation and the development of the Plan of Operation, the faculty member proposed for this advanced study had made other commitments. Instead of acquiring a substitute for him, it was decided to combine the study of manufacturing management and production in one course. As it turned out, this was an excellent adjustment in the program. In fact, had a separate offering been provided, the tight summer program could have been made unbearable.

The process of selection presented a substantial problem. As indicated in a previous section of this report, there were more than twenty applications for each participant position. The solution to this seemingly overwhelming task was simply the application of the most objective criteria to the data available. It must be kept in mind that some persons were rejected that could have contributed much to the success of the Institute.

Another problem that arose related to the process used in arriving at a format of style for the writing of sample instructional materials. After several trial sessions of planning, the decision was made by the staff to simply provide the format for the participants, since the participants did not wish to resolve differences among themselves by the democratic process.

Some data obtained from the Participants' Institute Evaluation Form point to other problems of some import. With regard to independent study, the participants did not feel the facilities and physical arrangements promoted such activity (see Item 3.5, Appendix D). In addition, the participants felt too little time was allowed for independent study (see Item 4.7, Appendix D). Together with this, the participants did not feel that group study was accomplished with any greater ease (see Item 3.6, Appendix D). No solutions were provided except to encourage the full use of the facilities available.

At the end of the first four weeks, the participants indicated that too much time was being spent on lectures in their advanced study. By the conclusion of the Institute, this problem was partially eliminated (see Item 4.1, Appendix D). Of course, this situation occurred because of the design of Institute activities. Certain concepts had to be presented through lecture-discussion to provide the basis for later stages of the program.

Another set of problems grew from the lack of participant free time and staff organized group events outside of regular Institute time. A reception was held by the Director on the Sunday afternoon preceding the opening of the Institute. Other than this, no social or recreational activities were organized by the staff. It was suggested by the Director that a social committee be elected and function in this capacity, but the participants did not so organize, even after several additional suggestions. Two picnics were initiated and held, but not all participants and staff attended. Ratings by participants on these items varied and are reported as Items 3.8, 4.8, and 4.9 in Appendix D. As can be seen by a study of these data, there was a considerable difference of opinion on these items. Some preferred to organize their own activities, while apparently some would have liked staff organized events. In general, the philosophy of the Institute staff (and of the University as a whole) reflects the idea that the participants were mature adult teachers fully capable of handling their own individual or group social and recreational needs. Apparently some of the participants appreciated this point of view while others would have preferred direction.

The last problem area to be presented relates to the adequacy of living accommodations. In general, these accommodations were rated by participants as "good" or "outstanding". Only four of the participants rated their quarters as low as "fair" (see Item 3.7, Appendix D). One participant had a home owner break an oral agreement two days before his arrival on campus. He had rented a house for his family but found that he had to make a last moment search for different accommodations. Within three days he obtained adequate housing. There appears to be no solution to the problem of family housing on the OSU campus. University dormitory facilities, excellent for single or double occupancy, are not designed for families but are readily available. Excellent University family housing units are available, but not in large number and are therefore not available for NDEA institutes on a block assignment basis. In most cases private family housing is most adequate within the community, but the possibility of group social solidarity is lost.

III. PROGNOSTICATIONS

This section of the report will cover the best estimates of the 1) potential effect of Institute activity on school programs, 2) potential effect of Institute activity on University programs, and 3) changes that would be made if the Institute were to be repeated again next year.

Potential Effect on School Programs

Based upon the expressed intentions of the participants, change should occur in their industrial arts programs through the use of the sample instructional materials developed during the summer. Some intend to use all of the materials. Others indicated only selected parts would be tried out. Some participants indicated a desire and an intent to develop similar materials that extend and amplify those written this summer.

Although the sample materials hold the greatest potential for effecting the most immediate change, a longer range effect must not be overlooked. This relates to the fundamental change in the philosophy of the participants. Almost without exception, these men have returned home with an understanding of the shortcomings of their present programs. In the opinion of the Director and other staff members, they will extend their efforts to bring about improvements along the lines outlined by Institute activity.

Potential Effect on University Programs

Unfortunately, change within the University takes place at a relatively slow pace. In general, graduate programs in industrial arts teacher education have been made up of an aggregate of more or less related courses. The NDEA Institute has demonstrated the desirability of focusing on a major problem area and directing the study and participant and staff energies toward the solution of that problem. If machinery can be set up in the future for University sponsored and supported programs like this, the regular graduate program will be improved many fold.

The obvious difficulty relates to the high participant support costs. Regardless of the improvement in graduate education (if the Institute pattern were followed), it is hypothesized that students would not be any more attracted to such programs without availabiltiy of stipend and dependent support monies.

Changes That Would Be Made

Comments within this subsection will follow generally the questions outlined in A Handbook for Directors, Item 19, pages 43 and 44. They are directed to the supposition that a similar institute would be held again.

If a similar institute were to be held, no change would be made in the objectives. The same grade level spread (7-8-9) would be maintained. The starting and ending dates would remain about the same, and the duration of eight weeks is optimum.

Some change would be made in the nature of the group of participants. Although the number of persons (24) was appropriate, their potential as change agents could have been improved. It was the general feeling of the staff that supervisors and teacher educators would have the greatest opportunity to bring about change (multiplying effect) when compared with classroom teachers.

As far as the code number is concerned, the Director feels that words rather than numerals convey the intent of the category. The code number per se is not understood by persons in the field without a word description; hence, it would be recommended that a code not be used as such.

With regard to distribution of time, it would appear that a future institute would need to be "loosened up" a bit. Less time would be spent in formal group lecture-discussion and more time would be made available for individual and informal group study.

The staff-participant ratio would be maintained with the exception that the one half-time position would be made into a full position. The budget calculations were excellent and would not be changed appreciably.

IV. SUMMARY (SPECIAL REPORT)

The Title XI NDEA Institute for Advanced Study in Industrial Arts conducted at The Ohio State University was a very successful endeavor, both as rated by the participants and by the staff. With regard to the five objectives set for the Institute, the overwhelming majority of the participants indicated that there had been relatively high realization of each of these objectives. These data are reported in Items 5.1 through 5.5 in Appendix D of this report. The participants indicated that they considered the overall plan and organization of the Institute, in the main, to be good to outstanding. These data are shown in Item 2.1 of Appendix D.

In a post-institute evaluation session, the staff of the Institute concurred with the judgments of the participants. It was felt that the Institute was highly successful in meeting the objectives set for it and that the overall organization and conduct were very effective.

Based upon the normative data provided by the Measurement Research Center at Iowa City, it would appear that the selection process was successful in designating a representative group of men as participants (see Appendices F and G). These participants were exceptionally able persons with high motivation and sense of purpose.

The most significant outcomes of the Institute have been the development of sample instructional materials in manufacturing and the assimilation of the requisite advanced knowledge of manufacturing technology and industrial arts curriculum theory. The Institute program was especially designed to have the participants develop sample materials based upon disciplined content and an internally consistent curriculum theory. Without such materials, the demonstration phase of educational innovation would have to wait upon some future development of the participants. With the materials in hand, the participants will be able to place into operation a program that has the potential to improve their industrial arts offerings.

Based upon experience, they will be able to adapt and extend these materials.

No major problems or shortcomings were experienced. Improvement could have been realized by allowing more free time for individual study and by providing more recreational and other social activities.

In summation, the Institute has provided a rich professional experience for participants and staff alike. Without question such programs should be continued and expanded, regardless of the source of initiation or financial support.

pages 21-49
(not available)

APPENDIX D

A Summary and Comparison of Participant Ratings of Selected Institute Elements at Mid-Institute and at The Completion of the Institute

N = 24

AREA 1

SKILLS AND KNOWLEDGE IMPARTED BY THE INSTITUTE

Question	Rating	4 Weeks	8 Weeks
1.1. Your success in increasing knowledge regarding the fields of manufacturing management and manufacturing production	5 Outstanding	8.3%	41.7%
	4 Good	50.0	58.3
	3 Fair	41.7	0
	2 Marginal	0	0
	1 Poor	0	0
	No Response	0	0
1.2. Your success in identification of subject matter essential to effective instruction in industrial arts	5 Outstanding	12.5	29.2
	4 Good	66.7	66.7
	3 Fair	16.7	4.2
	2 Marginal	0	0
	1 Poor	4.2	0
	No Response	0	0
1.3. Your success in increasing knowledge and skill in curriculum improvement and/or innovations	5 Outstanding	33.3	41.7
	4 Good	41.7	50.0
	3 Fair	20.8	8.3
	2 Marginal	0	0
	1 Poor	0	0
	No Response	4.2	0

AREA 2

QUALITY OF ELEMENTS OF THE INSTITUTE

2.1. Overall organization or structure of Institute	5 Outstanding	8.3	12.5
	4 Good	54.2	66.7
	3 Fair	33.3	20.8
	2 Marginal	4.2	0
	1 Poor	0	0
	No Response	0	0
2.2. Institute faculty	5 Outstanding	16.7	33.3
	4 Good	75.0	62.5
	3 Fair	8.3	4.2
	2 Marginal	0	0
	1 Poor	0	0
	No Response	0	0

Question	Rating	4 Weeks	8 Weeks
2.3. Guest speakers	5 Outstanding	16.7%	8.3%
	4 Good	45.8	29.2
	3 Fair	33.3	58.3
	2 Marginal	4.2	4.2
	1 Poor	0	0
	No Response	0	0
2.4. Conduct of Development Workshops	5 Outstanding	0	0
	4 Good	33.3	45.8
	3 Fair	41.7	37.5
	2 Marginal	16.7	12.5
	1 Poor	4.2	4.2
	No Response	4.2	0
2.5. Choice of field trips	5 Outstanding	41.7	29.2
	4 Good	33.3	62.5
	3 Fair	20.8	8.3
	2 Marginal	4.2	0
	1 Poor	0	0
	No Response	0	0
2.6. Conduct of field trips	5 Outstanding	20.8	29.2
	4 Good	50.0	50.0
	3 Fair	25.0	12.5
	2 Marginal	4.2	4.2
	1 Poor	0	4.2
	No Response	0	0
2.7. Choice of films	5 Outstanding	33.3	33.3
	4 Good	50.0	45.8
	3 Fair	16.7	20.8
	2 Marginal	0	0
	1 Poor	0	0
	No Response	0	0
2.8. Value of bulletin board displays	5 Outstanding	33.3	37.5
	4 Good	50.0	33.3
	3 Fair	12.5	29.2
	2 Marginal	4.2	0
	1 Poor	0	0
	No Response	0	0
2.9. Value of free and inexpensive materials from industry	5 Outstanding	33.3	45.8
	4 Good	50.0	33.3
	3 Fair	16.7	20.8
	2 Marginal	0	0
	1 Poor	0	0
	No Response	0	0

Question	Rating	4 Weeks	8 Weeks
2.10. Information received prior to Institute	5 Outstanding	83.3%	Only requested at mid-institute eval.
	4 Good	16.7	
	3 Fair	0	
	2 Marginal	0	
	1 Poor	0	
	No Response	0	

AREA 3

FACILITIES AND PHYSICAL ARRANGEMENTS FOR INSTITUTE

Question	Rating	4 Weeks	8 Weeks
3.1. Libraries	5 Outstanding	25.0	16.7
	4 Good	37.5	54.2
	3 Fair	16.7	29.2
	2 Marginal	12.5	0
	1 Poor	8.3	0
	No Response	0	0
3.2. Classrooms	5 Outstanding	45.8	41.7
	4 Good	45.8	45.8
	3 Fair	8.3	8.3
	2 Marginal	0	4.2
	1 Poor	0	0
	No Response	0	0
3.3. Development space	5 Outstanding	50.0	45.8
	4 Good	41.7	37.5
	3 Fair	8.3	12.5
	2 Marginal	0	4.2
	1 Poor	0	0
	No Response	0	0
3.4. Instructional equipment	5 Outstanding	29.2	25.0
	4 Good	62.5	62.5
	3 Fair	8.3	12.5
	2 Marginal	0	0
	1 Poor	0	0
	No Response	0	0
3.5. Independent study	5 Outstanding	4.2	20.8
	4 Good	29.2	37.5
	3 Fair	45.8	25.0
	2 Marginal	12.5	16.7
	1 Poor	4.2	0
	No Response	0	0

Question	Rating	4 Weeks	8 Weeks
3.6. Group study	5 Outstanding	8.3	8.3
	4 Good	29.2	41.7
	3 Fair	50.0	29.2
	2 Marginal	8.3	20.8
	1 Poor	0	0
	No Response	4.2	0
3.7. Living accommodations	5 Outstanding	45.8	45.8
	4 Good	37.5	37.5
	3 Fair	12.5	16.7
	2 Marginal	0	0
	1 Poor	4.2	0
	No Response	0	0
3.8. Recreation	5 Outstanding	12.5	8.3
	4 Good	29.2	37.5
	3 Fair	45.8	25.0
	2 Marginal	0	16.7
	1 Poor	12.5	12.5
	No Response	0	0

AREA 4

AMOUNT OF TIME APPORTIONED TO INSTRUCTIONAL METHODS

4.1. Lecture	3 Too much	70.8	37.5
	2 About right	29.2	58.3
	1 Too little	0	4.2
	No Response	0	0
4.2. Audio-visual presentations	3 Too much	0	4.2
	2 About right	100.0	91.7
	1 Too little	0	4.2
	No Response	0	0
4.3. Development Workshops	3 Too much	0	4.2
	2 About right	37.5	50.0
	1 Too little	54.2	45.8
	No Response	8.3	0
4.4. Seminars	3 Too much	0	20.8
	2 About right	91.7	79.1
	1 Too little	8.3	0
	No Response	0	0

Question	Rating	4 Weeks	8 Weeks
4.5. Field trips	3 Too much	0	8.3
	2 About right	79.1	75.0
	1 Too little	20.8	16.7
	No Response	0	0
4.6. Guest speakers	3 Too much	0	4.2
	2 About right	91.7	83.3
	1 Too little	8.3	12.5
	No Response	0	0
4.7. Individual study periods	3 Too much	0	4.2
	2 About right	20.8	50.0
	1 Too little	79.1	45.8
	No Response	0	0
4.8. Free time	3 Too much	0	0
	2 About right	41.7	54.2
	1 Too little	58.3	45.8
	No Response	0	0
4.9. Group events outside regular Institute time	3 Too much	0	0
	2 About right	45.8	50.0
	1 Too little	41.7	50.0
	No Response	12.5	0

AREA 5

EXTENT TO WHICH OBJECTIVES OF THE INSTITUTE ARE BEING REALIZED

5.1. To help participants increase their knowledge of industry through advanced study of industrial management practices and industrial production practices	5 High	12.5	45.8
	4 Realization	37.5	45.8
	3	33.3	8.3
	2 Low	12.5	0
	1 Realization	4.2	0
	No Response	0	0
5.2. To help participants gain an understanding of alternative approaches in structuring the body of knowledge of the field of industrial arts	5 High	37.5	37.5
	4 Realization	41.7	45.8
	3	16.7	16.7
	2 Low	0	0
	1 Realization	0	0
	No Response	4.2	0

Question	Rating	4 Weeks	8 Weeks
5.3. To help participants develop an internally consistent rationale for projecting curriculum development	5 High	20.8	16.7
	4 Realization	37.5	62.5
	3	33.3	20.8
	2 Low	4.2	0
	1 Realization	0	0
	No Response	4.2	0
5.4. To help participants increase their skills in writing curriculum materials and developing laboratory experiences	5 High	0	29.2
	4 Realization	45.8	45.8
	3	33.3	20.8
	2 Low	12.5	4.2
	1 Realization	0	0
	No Response	8.3	0
5.5. To help participants gain knowledge of the rich instructional resources available from industry	5 High	16.7	41.7
	4 Realization	58.3	45.8
	3	20.8	12.8
	2 Low	0	0
	1 Realization	0	0
	No Response	4.2	0

pages 52-65
not available

APPENDIX H

Roster of Participants

THE OHIO STATE UNIVERSITY

NDEA Industrial Arts Institute
"Advanced Study of the Manufacturing Industries
and Curriculum Materials Development in
Manufacturing for the Junior High School"

Roster of Participants*

Name	Home Address	Preinstitute School Address	Postinstitute School Address
Ballard, Neil E.	118 College Drive Abilene, Texas 79601	Madison Junior High School 3145 Barrow Street Abilene, Texas 79605	
Barnhill, John H.	R. D. #2 Perrysville, Ohio 44864	Budd Junior High School 210 Main Street Loudonville, Ohio 44842	
Blankenbaker, E. Keith	33 Maryann Court Florissant, Missouri 63031	Brittany Junior High School 8125 Groby Road University City, Missouri 63130	
Bonar, Vern M.	5306 Riggs Mission, Kansas 66202	Old Mission Junior High School 4901 Reinhardt Shawnee-Mission, Kansas 66205	
Briscoe, Hammond J. Jr.	3209 Yosemite Avenue Baltimore, Maryland 21215	Harlem Park Junior High School Harlem and Gilmor Streets Baltimore, Maryland 21217	
Cadwell, Ernest D.	Box 45 Spring Church, Pennsylvania 15686	Apollo High School Apollo, Pennsylvania 15613	

*June 19 - August 11, 1967

Name	Home Address	Preinstitute School Address	Postinstitute School Address
Cameron, James L.	1169 Lockwood Road Columbus, Ohio 43227	Barrett Junior High School 345 Deshler Avenue Columbus, Ohio 43227	Yorktown Junior High School 5600 East Livingston Avenue Columbus, Ohio 43227
Collins, John E.	3701 Northwood Orchard Lake, Michigan 48003	Barnum Junior High School Birmingham, Michigan 48003	
Cullings, Forrest L.	3326 Allison Avenue Indianapolis, Indiana 46224	Northview Junior High School 8401 Westfield Boulevard Indianapolis, Indiana 46240	
Cutler, Robert W.	7114 South 2825 East Salt Lake City, Utah 84121	Irving Junior High School 1179 East 21st South Salt Lake City, Utah 84106	
Darrow, Donald R.	903 West Third Street Cedar Falls, Iowa 50613	Malcolm Price Laboratory School University of Northern Iowa Cedar Falls, Iowa 50613	
Davis, Terry L.	11803 North Lane, Apt. 5 Lakewood, Ohio 44107	Emerson Junior High School 13439 Clifton Boulevard Lakewood, Ohio 44107	Experienced Teacher Fellowship in Industrial Arts Wayne State University Detroit, Michigan 48202
Eckhardt, Louis J.	31 Jewett Avenue Tenafly, New Jersey 07670	Roy W. Brown Junior High School 130 S. Washington Avenue Bergenfield, New Jersey 07621	
Kelsey, David N.	1214 N. W. 4th Richmond, Indiana 47374	Randolph Southern Junior High R.F.D. #2 (Spartansburg) Lynn, Indiana 47355	
Langman, Harry S.	1587 N. E. 174 Street North Miami Beach, Florida 33162	Westview Junior High School 1901 N. W. 127 Street Miami, Florida 33167	Norland Senior High School 1050 N. W. 195th Street Miami, Florida 33169

Name	Home Address	Preinstitute School Address	Postinstitute School Address
Nadzam, Andrew J.	769 Brookfield Avenue Youngstown, Ohio 44512	Board of Education 20 West Wood Street Youngstown, Ohio 44503	
Pucel, Joseph L.	4518 Colorado Avenue, North Minneapolis, Minnesota 55422	Hosterman Junior High School 5530 Zealand Avenue, North Minneapolis, Minnesota 55428	
Ray, Delbert L.	712 Darrow Drive Tempe, Arizona 85281	Gililland School 1025 Beck Avenue Tempe, Arizona 85281	
Settles, Homer W.	209 Dill Street Bowling Green, Ohio 43402	Bowling Green Junior High School West Wooster Street Bowling Green, Ohio 43402	
Tanner, Clay F.	4900 Ridgerun Drive Columbus, Ohio 43224	Dominion Junior High School 330 E. Dominion Boulevard Columbus, Ohio 43224	
Williams, Harrison	1938 Elizabeth Avenue North Chicago, Illinois 60064	Jack Benny Junior High School 1401 Montesano Waukegan, Illinois 60085	
Williams, Thomas E.	421 North 22nd Street Battle Creek, Michigan 49015	Springfield Junior High School 1023 Avenue A Battle Creek, Michigan 49015	
Wooden, William H.	1702 Indiana Avenue La Porte, Indiana 46350	Central Junior High School 1000 Harrison Street La Porte, Indiana 46350	
Woolery, Eugene	403 Sandalwood Drive Dayton, Ohio 45405	Orville Wright School 200 South Wright Avenue (45404) Gorman School 156 Grant Street (45404) Webster School 1115 Kiefer Street (45403) Dayton, Ohio	

pages 70 —
not available

ED 065731

industrial arts

ndea
institute
for
advanced
study

manufacturing

the ohio state university
1967

~~VT 015 741~~
VT 016 273

39

FILMED FROM BEST AVAILABLE COPY

Instructional Materials
in
MANUFACTURING
for
Junior High School Industrial Arts

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION
THIS DOCUMENT HAS BEEH REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL OFFICE OF EDUCATION POSITION OR POLICY.

Part I of IV
Generalized Manufacturing Technology Regardless of Product

Summer 1967

NDEA Institute for Advanced Study
in Industrial Arts
The Ohio State University
Columbus, Ohio
43210

Part I of IV

Generalized Manufacturing Technology
Regardless of Product

Other Instructional Materials
In This Series

Product Synthesis A Part II

Product Synthesis B Part III

Product Synthesis C Part IV

41

PREFACE

In keeping with the increasing tempo of change in industry and its technology, industrial arts programs in the schools must change. As a catalyst for change, new and improved instructional materials must be developed to assist industrial arts teachers in the interpretation of the complex field of industrial technology. There is a dearth of commercial textbooks and other materials in the field of industrial arts that treat manufacturing, one dimension of industrial technology, as a managed production system. Because of this need, a Summer NDEA Institute for Advanced Study in Industrial Arts was designed and conducted at The Ohio State University. As one outcome of this Institute, sample instructional materials in manufacturing technology have been developed.

The participants of the Institute were a highly selected group of men in their field. The group was composed of teachers, heads of departments, and supervisors of industrial arts at the junior high school level. The names and professional positions of these men are listed in the "Contributors" section of this document.

The formal program of the Institute provided the participants with (1) a detailed study of new industrial arts curriculum plans or structures that are being proposed across the United States, and (2) advanced substantive study in manufacturing management, personnel, and production technology. This study was supplemented by field inspection trips to a variety of manufacturing establishments. Films and series of free and inexpensive materials on manufacturing were available to extend the study. Visiting lecturers representing the fields of the history of technology, industrial arts curriculum, industrial design, manufacturing ownership and manufacturing labor participated in the Institute. The components of the program were provided integration by the instructional materials development workshop portion of the Institute. In this workshop the manufacturing instructional materials were developed.

The professional staff and their responsibilities are listed below:

Dr. Donald G. Lux, Professor of Education
The Ohio State University--Advanced Industrial Arts Curriculum

Dr. Donald R. Kibbey, Assistant Professor of Industrial Engineering, The Ohio State University--
Advanced Manufacturing Management, Personnel and Production Technology

Dr. Arthur W. Earl, Professor and Chairman, Department of Industrial Education and Technology
Montclair State College, Montclair, New Jersey--
Instructional Materials Development

Arthur J. Rosser, Doctoral student in Industrial Arts, The Ohio State University--
Administrative Assistant

John Butala, Jr., Doctoral student in Industrial Arts, The Ohio State University--
Instructional Assistant

Phillip A. Fazzini, Doctoral student in Industrial Arts, The Ohio State University--Instructional Assistant

Miss Grace M. Twine--Secretary

The impact of this Institute and other efforts similar to it should be felt soon at the local and state levels. With professional effort and dedication, industrial arts teachers can move ahead with instructional materials such as these and develop more extensive materials for themselves and the profession.

Willis E. Ray, Director
NDEA Institute for Advanced Study in Industrial Arts
The Ohio State University
August, 1967

INTRODUCTION

The materials presented in this volume were developed by participants of the Summer 1967 NDEA Institute for Advanced Study in Industrial Arts held at The Ohio State University. The title of the institute was "Advanced Study of the Manufacturing Industries and Curriculum Materials Development in Manufacturing for the Junior High School".

All materials contributed by the participants were prepared for the junior high school level. The ideas presented were originally conceived, written, and illustrated. The general pattern or framework of the materials was adapted from the structure of manufacturing technology developed by the Industrial Arts Curriculum Project (IACP).

The general approach and organization of the development workshop portion of the Institute was structured cooperatively by the participants and the professor. The following ten considerations were important to the successful development of the materials:

1. The group developed an acceptable format of style for writing and illustrating the instructional material. All of the instructional material was to be written succinctly.

2. Participants selected suitable and sequential topics for development from the manufacturing technology structure. The topics became the participants' context for writing.

3. Considerable time and study went into researching each topic. This study involved the delineation

of the sub-concepts within each larger context.

4. An attempt was made to state objectives in terminal behavioral form specifically related to each context.

5. Each topic was to be introduced by referral to the previous higher order of the manufacturing structure.

6. The text material was to present the body of knowledge (sub-concepts of the context) in a logical series of events and cover the topic adequately.

7. The summary was to recapitulate the key concepts and details of the context succinctly.

8. Illustrations were to relate directly to the text, supplement the text, present one concept, and use color functionally.

9. To support each reading unit, one or more laboratory activities were to be developed. The laboratory activities were to be simple reinforcing experiences, related directly to the context.

10. Emphasis was placed upon the 7th grade readability level during the entire development of the instructional material. Prior to their first writing the participants were instructed in basic readability rules. The participants were later instructed in the use of the Dale-Chall readability formula, which they constantly applied as they continued to develop and edit their instructional material.

    The finished materials were written for the 7th-8th grade reading level. However, the inclusion of numerous technical words, essential to manufacturing processes, poses a slight technical writing problem. Therefore each new technical word was to be underscored and defined.

The instructional material developed during this N.D.E.A. Institute has been based upon a structured body of knowledge and laboratory activity has been considered essential to the thorough understanding of this knowledge (manufacturing technology). Industrial arts teachers are encouraged to adopt or adapt any or all of this material as one means for the improvement of industrial arts instruction.

Arthur W. Earl, Professor
Instructional Materials
Development Workshop

CONTRIBUTORS

Ballard, Neil E.
Madison Junior High School
Abilene, Texas 79605

Barnhill, John H.
Budd Junior High School
Loudonville, Ohio 44864

Blankenbaker, E. Keith
Brittany Junior High School
University City, Missouri 63130

Bonar, Vern M.
Old Mission Junior High School
Shawnee-Mission, Kansas 66205

Briscoe, Hammond J., Jr.
Harlem Park Junior High School
Baltimore, Maryland 21217

Cadwell, Ernest D.
Apollo High School
Apollo, Pennsylvania 15613

Cameron, James L.
Yorktown Jr. High School
Columbus, Ohio 43227

Collins, John E.
Barnum Junior High School
Birmingham, Michigan 48003

Cullings, Forrest L.
Northview Junior High School
Indianapolis, Indiana 46240

Cutler, Robert W.
Irving Junior High School
Salt Lake City, Utah 84106

Darrow, Donald R.
Malcolm Price Laboratory School
University of Northern Iowa
Cedar Falls, Iowa 50613

Davis, Terry L.
Emerson Junior High School
Lakewood, Ohio 44107

Eckhardt, Louis J.
Roy W. Brown Junior High School
Bergenfield, New Jersey 07621

Kelsey, David N.
Randolph Southern Junior High
Lynn, Indiana 47355

Langman, Harry S.
Westview Junior High School
Miami, Florida 33167

Nadzam, Andrew J.
Board of Education
Youngstown, Ohio 44503

Pucel, Joseph L.
Hosterman Junior High School
Minneapolis, Minnesota 55428

Ray, Delbert L.
Gililland School
Tempe, Arizona 85281

Settles, Homer W.
Bowling Green Junior High School
Bowling Green, Ohio 43402

Tanner Clay F.
Dominion Junior High School
Columbus, Ohio 43224

Williams, Harrison
Jack Benny Junior High School
Waukegan, Illinois 60085

Williams, Thomas E.
Springfield Junior High School
Battle Creek, Michigan 49015

Wooden, William H.
Central Junior High School
La Porte, Indiana 46350

Woolery, Eugene
Orville Wright School
Gorman School
Webster School
Dayton, Ohio 45405

TABLE OF CONTENTS

Topic Page Contributor

INTRODUCTION

Man and Technology . . . . 1.1 J. E. Collins
Industrial Technology. . . . . . . 2.1 D. L. Ray
Manufacturing Technology . . . . 3.1 J. L. Pucel

PERSONNEL

Hiring . . . . 4.1 L. J. Eckhardt
Working . . . . 5.1 H. W. Settles
Training, Advancing, & Retiring. 6.1 E. Woolery

MANAGEMENT

Planning . . . . 7.1 H. S. Langman
    Researching . . . . 8.1 J. H. Barnhill
    Designing . . . . 9.1 N. E. Ballard
    Engineering . . . . 10.1 R. W. Cutler
Organizing . . . . 11.1 F. L. Cullings
Controlling . . . . 12.1 V. M. Bonar

PRODUCTION

Pre-Processing . . . . 13.1 T. L. Davis
Processing . . . . 14.1 A. J. Nadzam
    Primary Processing. . . . . . . 15.1 D. N. Kelsey
        Refining . . . . 16.1 E. D. Cadwell
        Converting . . . . 17.1 C. F. Tanner
        Bulk Forming . . . . 18.1 D. R. Darrow
    Component Processing . . . . 19.1 J. L. Cameron
        Separating . . . . 20.1 W. H. Wooden
        Combining . . . . 21.1 T. E. Williams
        Forming . . . . 22.1 E. K. Blankenbaker
    Assembly Processing . . . . . 23.1 H. Williams
Post-Processing . . . . 24.1 H. J. Briscoe

MAN AND TECHNOLOGY

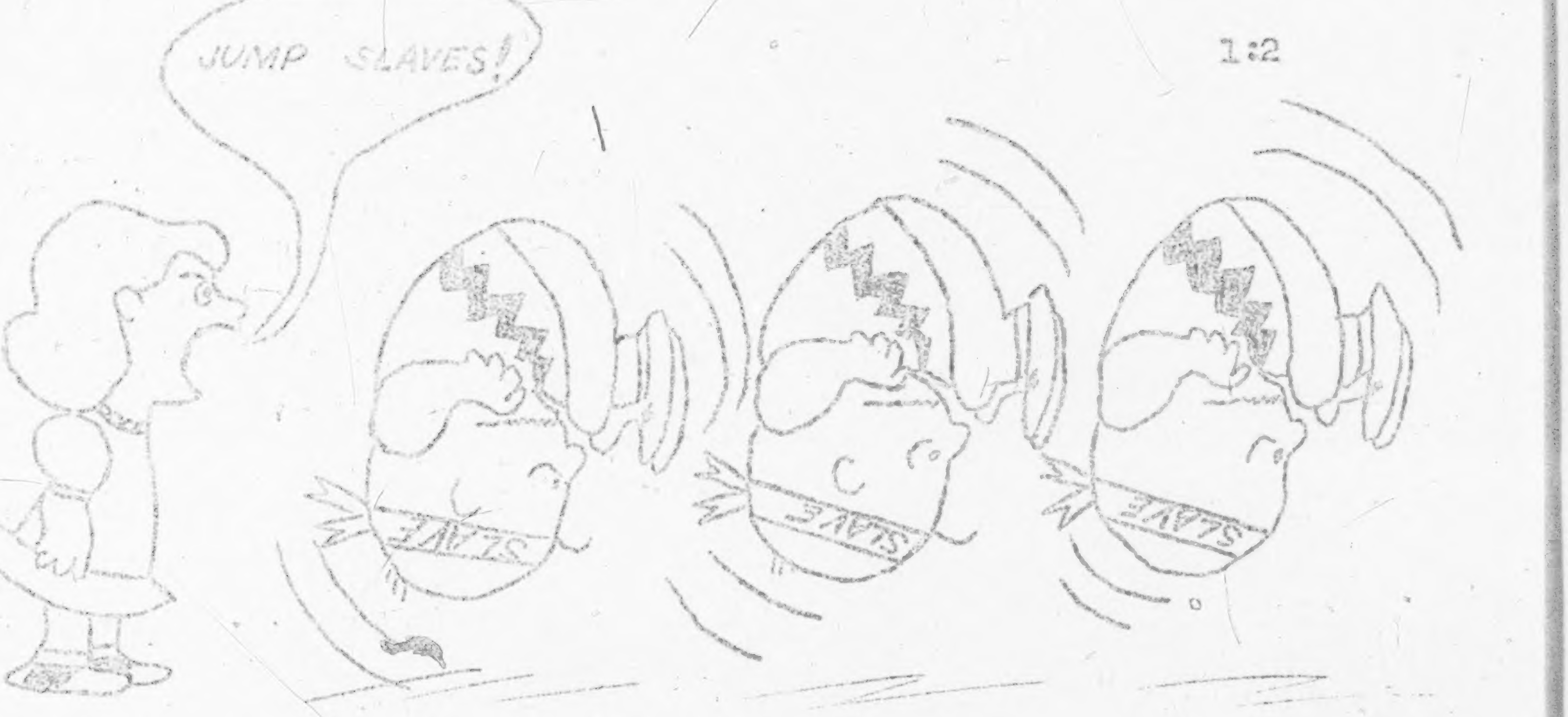
OBJECTIVES

1. To give an over-view (short history) of the origin of man's technology.
2. To have the student understand that man uses technology in all 5 basic social insitutions. (1) religion (2) goverment (3) family (4) education and (5) economic
3. To have the student be aware of the circumstances which led up to the United States being the world leader in using technology.

INTRODUCTION

A boy or girl born in the 1950's thinks nothing of turning on the family television set. They take it for granted because they have never known a time when there was no television. They seem to have come into a world which is ready made for them. The electric lights come on at the flick of a switch. The exact temperature in their homes is maintained by the setting of a dial. The deep freeze preserves food for the next few months. Turn a key and a powerful automobile is ready to transport you across town or across the nation. All of these wonders, and many more, are products of man's technology.

Our industrial economy has given us the highest scale of living ever enjoyed by any civilization. In the late days of the Roman Empire (about 229 A.D.) slaves outnumbered free men in Rome three to one. Every american has 260 slaves per capita on an energy basis. (Fig.A)


JUMP SLAVES!
SLAVE
SLAVE
SLAVE

ROMAN EMPIRE 299 A.D.

HELP ME MR TECH!
MR.
TECH

TODAY, TECHNOLOGY PROVIDES EVERY AMERICAN WITH MACHINES THAT WILL DO THE WORK OF 260 HUMAN SLAVES.

TECHNOLOGY DOES OUR WORK TODAY

FIG. A

We ordinarily think of technology as something mechanical. Something which changes materials to increase their value for human usage. In an economic sense this is true. However, technology is of interest to us not only because of the products which we produce but because of the many ways it affects our society. Technology affects our religions, our goverments, our family, our education and our economics. Technology has altered nearly all the basic components which make up the life of man.

RELIGION

During the middle ages (AD 476 to about AD 1500) the monasteries played a major part in the development of machinery. They were especially important in various applications of the water wheel. Each monastery had to meet all its own needs for food, clothing, and tools. To avoid unnecessary labor, which reduced the time available for meditation and prayer, every thing was as mechanized as possible. They used water power to grind corn, make flour, crush grapes for wine, operate a tannery, operate an iron mill and a forge. Local farmers would bring products of their fields to the monasteries for processing. They would buy tools, cloth, leather and wine from the monks. The monasteries formed the sole economic base of the middle ages. This is only one example of how religion and technology are tied together. Modern technology has brought new urgency to some of mankind's most cherished religious ideas. Technology has created instruments of distruction which make it imperative that we begin taking our religious teaching seriously if man is to survive.

GOVERMENT

Throughout most of our history, the United States has been isolationist in nature. (This means ignoring the problems of the rest of the world). We now realize that this kind of thinking is no longer possible. Because of technology the ocean no longer provides a natural barrier seperating us from the problems of the rest of the world. It takes only 30 minutes for a nuclear guided missile to go half way around the world. Technology has forced us to change some of our traditional political and economic attitudes. The world is now interdependent (depending on one another) in terms of raw materials and trade. These are only a few examples of how technology has affected goverment. Can you think of other ways? How about taxes? Does industry pay taxes to support our goverment? Does the goverment ever supply money for industry to grow or exist?

FAMILY

At the same time that technology was urbanizing America, it was also having its affect on the American family. The entire family had worked together on the farm.

Father and sons worked side by side in the fields while mother and daughter worked together in the kitchen. Families were together from morning till night. Compare this with the family of today, that reside in the city. The father works in an industrail plant or office which is miles from home. He no longer works with his sons. The rest of the family have never seen the work which he performs. The automobile makes it possible for the family to be widely separated. More leisure time is now available and the American family has more buying power than ever before. All these things and many more can be attributed to our changing technology.

EDUCATION

When your great grandfather went to school, few people continued past the eighth grade. All that was needed to be a good citizen was reading, writing and arithmatic. In 1860 a U. S. Senator suggested that the United States Patent Office be closed. I wonder what that senator would say if he were here today? Thousands of patents are issued every year. If people are to be well informed citizens in this age of technology more and more education is required. If a person is going to keep informed about his vocation and the world around him he can never stop learning. To stop in this fast moving age is to fall by the wayside. Each year the goverment spends millions of dollars re-educating people. The skills they learned earlier are no longer needed. This is because technology is constantly changing.

ECONOMICS

Technology has affected economics more than any other area of our society. When America was young 80% of its people had to work on farms to feed the nation. Now, with the help of machines, less than 20% of our people raise enough food for not only our country but for much of the rest of the world. With fewer people on the farms, more people are free to work in industry.

Mass production reduces cost which, in turn, produces a large home market and a high standard of living. Industry has built research and development laboratories to further increase its efficiency. Productivity per man, through mechanization, is constantly increasing. A fair and efficient sharing of the profits among owners, workers and consumers means that our standard of living will continue to improve.

MAN AND TECHNOLOGY

Anthropologists (men who study man's development and history) are not able to agree on the date for the first coming of man on the earth. The range generally accepted is between a quater of a million and a million and a half years ago. Let's take the smallest estimate, 250,000 years, and reduce it to the scale of one hour. Some sense of the relative time spent in various technical developments can be viewed. The first 56 1/2 minutes of this hour were spent in the stone age. Just think, more than 11/12 of the time man has been on earth, he spent in the stone age. 3 1/2 minutes ago he began the working of copper. Only 2 1/2 minutes ago he began to mold bronze. 2 minutes ago he learned to melt iron. 1/4 of a minute ago he learned printing. 5 seconds ago the Industrial Revolution began. 3 1/2 seconds ago he learned to use electricity. The time that man has used automobiles is less than the interevals between the ticks of your watch. (In other words, less than one second). The significance of this comparison is to show that the age of science and technology is still very, very young. (Fig. B)

Let's go back in time and take a look at man's technical achievements.. Since the beginning of time the most conspicious (obvious or notable) members of society have been kings and military men. The ones who have been engaged in struggles for power, riches and land. At the same time other members of society have been writing a different story--the story of technology.

1:8

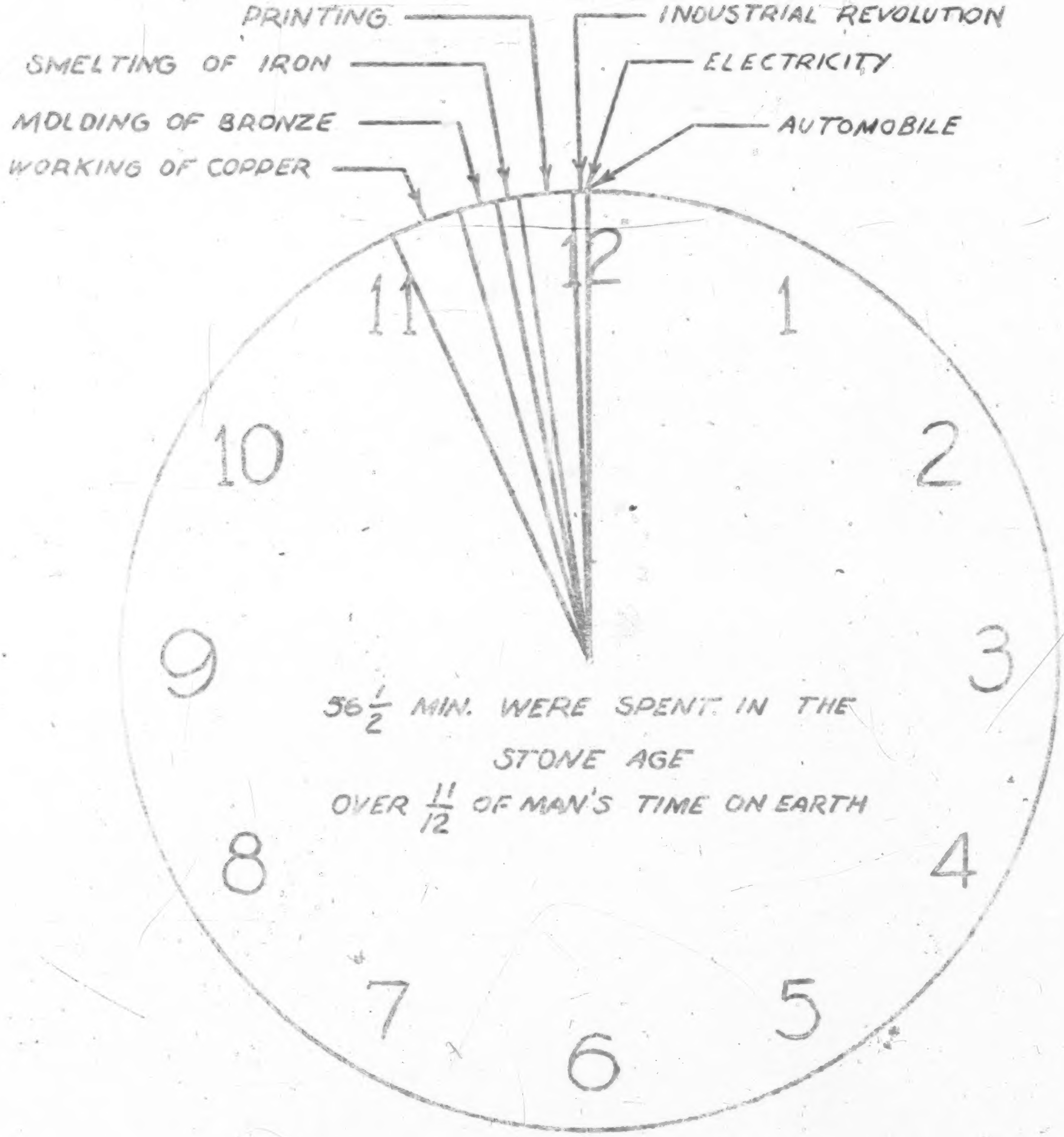

PRINTING
SMELTING OF IRON
MOLDING OF BRONZE
WORKING OF COPPER
INDUSTRIAL REVOLUTION
ELECTRICITY
AUTOMOBILE
12
1
2
3
4
5
6
7
8
9
10
11
$56\frac{1}{2}$ MIN. WERE SPENT IN THE STONE AGE
OVER $\frac{11}{12}$ OF MAN'S TIME ON EARTH

FIG. B

TIME-CLOCK

The time clock shows that within the time span of human life on earth, the age of science and technology is still very very young.

FILMED FROM BEST AVAILABLE COPY

STONE AGE

All through the stone age mankind developed and improved stone tools. It was during this period that the wheel was discovered. He learned it was better to farm than depend on wild plants and animals. He began spinning and weaving to make cloth. It was during the stone age that man made the important discovery of fire. Fire was the first source of external power that man used. Until that time man was limited to the energy inside his own body. Fire has been the key to his rapid rise in mastering the forces of nature.

WORKING OF COPPER AND BRONZE

The ancient river civilizaions produced copper tools. Almost pure copper was found on or near the surface of the ground. These chunks of copper were heated and shaped into tools. These were soft and not enough superior to stone tools to entirely replace them. Finally someone discovered that by mixing one part of tin, a new metal, with nine parts of copper, a much harder tool could be produced.

IRON AGE

The Greeks discovered how to make wrought iron as early as 2500 B.C. They took the spongy mass of iron and slag (impurites) and eliminated the slag by repeated hammering. This fairly pure iron was malleable (capable of being hammered into a desired shape without breaking) but not as hard as bronze. About a thousand years later the greeks discovered that wrought iron, frequently reheated in a charcoal fire and then hammered, became much harder than bronze. Iron, or steel, rapidly replaced bronze in weapons and tools. Forests began to vanish before the steel axe. More land was plowed with the superior steel plow shares.

Following the downfall of the Roman Empire, Western Europe becomes our chief interest. It was there that the story of technology was continued. In spite of the fact that Rome occupied most of Western Europe for over four centuries, she did little to civilize the area. She left no schools, and no goverment. Rome left only a few bridges, aqueducts (water pipes) and roads. The inhabitants were still barbarians who could neither read or write. All work was done by hand except for a few work animals, wind-mills and primitive water wheels. No one was interested in labor saving devices because slave labor was so cheap.

PRINTING

Until the middle of the fifteen century very little printing was done. There were really only two ways of doing it. One way was to copy other printing by hand, letter by letter and word by word. This was the process used in the monasteries. The other way was to carve out the letters and pictures on a solid block of wood and then print from the wooden block. This was very slow and so expensive that only the richest people could own a book.

In 1452 Johann Gutenberg developed a system of making single letters out of wood and later out of metal. These single letters (now called type) could be arranged to spell words. The type could be taken apart and used over and over again. This system was such a great imporvement that books and printing became common throughout Europe and the rest of the world. Here was man's first rapid means of communication. Now as technology advanced it could be recorded and shared with the rest of mankind in a short time.

INDUSTRIAL REVOLUTION---STEAM ENGINE

In 1712 James Watt invented the steam engine. It was the first time that a substitute had been found for human labor on such a grand scale. Until this time man could produce only three times his own muscle strength with animals, water power and hand tools. That is, he could do three times the amount of work with these early devices. The steam engine was a power source which enabled man to increase his strength by 10,000 times. This invention eventually made slavery unprofitable so it disappeared.

Watt's engine started the Industrial Revolution in England. The revolution migrated to the United States almost as soon as it was started. In time we added to it interchangeablility of parts, (ability to change or altenate parts) and mass production.

The Industrial Revolution in the United States did not just happen to come about; it was caused. Let's look at some of these reasons. When the independence of the United States was achieved, everyone who could, moved west to settle on free land. Among the first to go were the mechanics. The men who were skilled in the use of tools. The result was that throughout young America there were no large groups of skilled mechanics of any kind. In every branch of technology America was far behind England. The migration into the wilderness, at first, did not produce great needs. The first work of clearing forests, plowing the fields, and building cabins meant that only a few tools were needed. Anything the settlers needed they built themselves or went without.

But once farmers began planting and harvesting the tremendous crops, there was no time to make their own tools, cloth, shoes, etc. It was then, when the first money had come from their crop sales, that the westerners began to want every kind of manufactured goods; cloth, shoes, hardware, glass, flour, clocks, and hundreds of other things. A tremendous market quickly grew. At first America looked to Europe for help. But Europe had been plunged into war. Napoleon was sweeping across the contienent. The United States was truly thrown on its own. Our only hope was to produce as much and as fast as possible.

Some substitute had to be found for the missing men who had gone west. It was then that a handful of great mechanical geniuses answered this call. Machines had to be invented which would take the place of ten, twenty or a hundred men. America answered this challange and has been answering it ever since. Today America is second to none in our standard of living; the result of our technology.

SUMMARY

American's have the highest standard of living in the world. This is the result of our use of technology. We have learned to build machines which are stronger, faster and more accurate than humans. This technology, affects more than just our economy. It affects all 5 basic social institutions, the family, religion, goverment, education and economy.

History tells us that man's achivements have not come easily or quickly. Man has been on this earth for at least 250,000 years. 11/12 of this time man was in the stone age. With fire he learned to work copper, make bronze and smelt iron. The printing press and moveable type enabled technology to be recorded and shared with all mankind. James Watt's steam engine started the Industrial Revolution. Up to this time the machine used by man had to be small enough to be powered by human, animal or water power. The steam engine increased man's strength by 10,000 times. The idea of interchangeable parts was the key which unlocked mass production.

The United States was ready for the Industrial Revolution. We were short skilled workers Therefore tremendous markets developed for materials and industrial workers as the settlers moved westward. Machines had to be invented which would take the place of many men. America answered this challange and has become the world leader in the use of technology.

LABORATORY ACTIVITY

Objectives

1. To show an example of primative tool making in comparison to modern day manufacturing in the United States.
2. To help the student realize that without technology his standard of living would be little different than those of primative men.

These objectives will be meant by showing the film, "One Hoe For Kalabo". It tells the story of primative tool making in Africa in comparison to modern day manufacturing in the United States. It is a 27 minute color movie which was made for the National Machine Tool Builders Association. It is availiable from: Modern Talking Picture Service, 1212 Avenue of the Americas, New York, New York 10036

INDUSTRIAL TECHNOLOGY

OBJECTIVE

To learn the importance of industrial technology in our lives.

INTRODUCTION

We live in a wonderful age. A time that is filled with many industrial (of or relating to industry) wonders. Industry, using machines and tools, is the activity which changes material into products we want. It gives us the food we eat. It gives us the clothes we wear and the houses we live in. These are the things needed for life.

Think about other products we buy. Think about our ways of traveling from place to place. Automobiles are seen everywhere. Trains speed across the country. Jet planes roar through the skies. Now think about the wonders of space travel. Rockets are sent far from earth. (Fig. A).

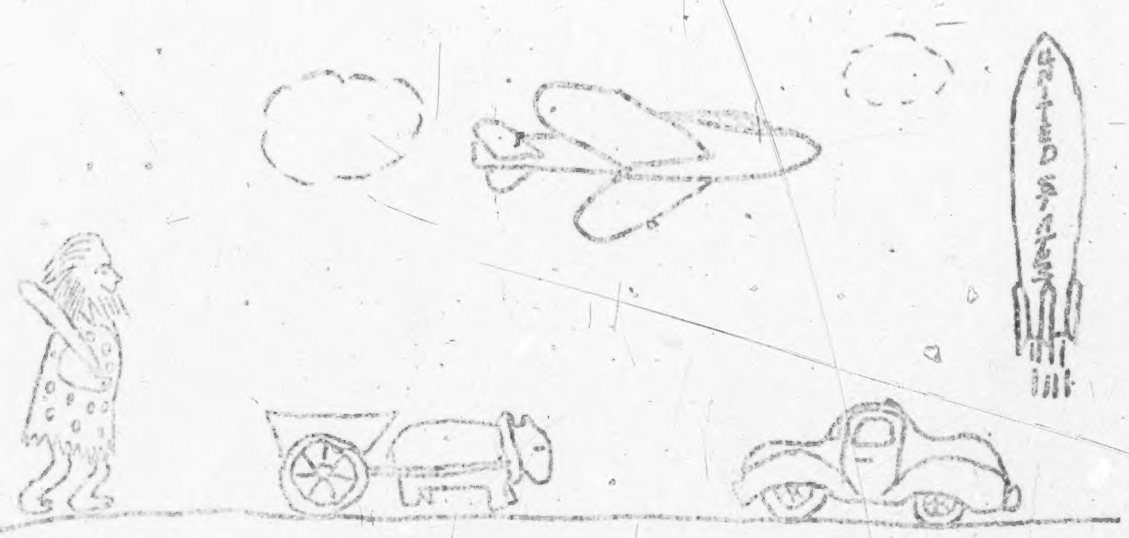


FIG. A) TRANSPORTATION
YESTERDAY AND TODAY

Man will soon be able to go to other planets. The machines and tools we use are all products of industrial technology. Industrial technology includes all the skills, knowledges, and activities it takes to give us the things we want and need.

The story of man's struggle for economic security begins with birth. He has used his brain to think of new and better ways to make things. Many of the products are made to satisfy his wants and needs. Others are to make his life and work easier. The first stages of development were very slow. Today we advance much faster because of the use of machines and tools. Without technology, man would not have machines and tools to work for him.

The industries of modern life represent technology. They supply the daily wants and needs of millions of people. Industry has been very successful in using man and nature. Man has invented many machines and tools. These machines and tools are then used to transform (change) the raw materials of nature into useful products. Industry is making better use of man and nature now than in any other period of history.

One big reason for our success is that we have found and used new sources of power. (Fig. 8). At one time power was obtained from water wheels, windmills, work animals, and man himself. Workers of today can produce 3 to 300 times more than the workers of 100 years ago. Today about 99 percent of the power used comes from coal, oil, gas, or water. Atomic energy is also being used for power. These new sources

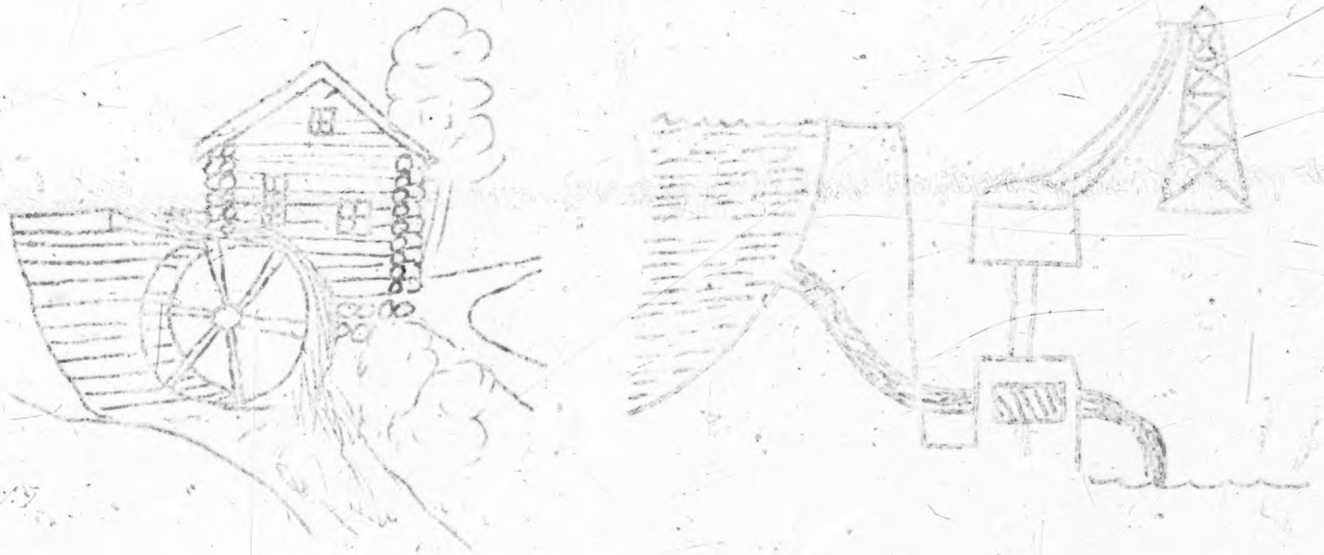


FIG. B YESTERDAYS WATER-WHEEL AND TODAYS TURBINE GENERATING POWER

of power have helped man to increase his work output.

The demand for new and better products is at an all time high. Workers have more leisure time than ever before. The work week is shorter. Many products of industry work for us. Homes are heated and cooled automatically. Washers and dryers do the family laundry. Food is stored in refrigerators and freezers. All types of transportation is available. Our homes have many electrical labor saving devices. All of these things have been made possible through modern industry.

Modern industry has made its greatest growth under the free enterprise system. Free enterprise sets man free to make his own decisions. It gives him freedom to seek and to build mass markets. He can look for better ways to build things. He is free to try all kinds of new ideas in many areas. The people of this country have the highest standard of living of any nation. The American people have always wanted to make more, to make it better, and to make it at lower cost.

THE MAKE UP OF INDUSTRY

Industry is made up of three basic elements or parts. These elements are management, personnel, and production. These elements when put together with raw materials, men, and capital (money) make up our present industries. (Fig. C).

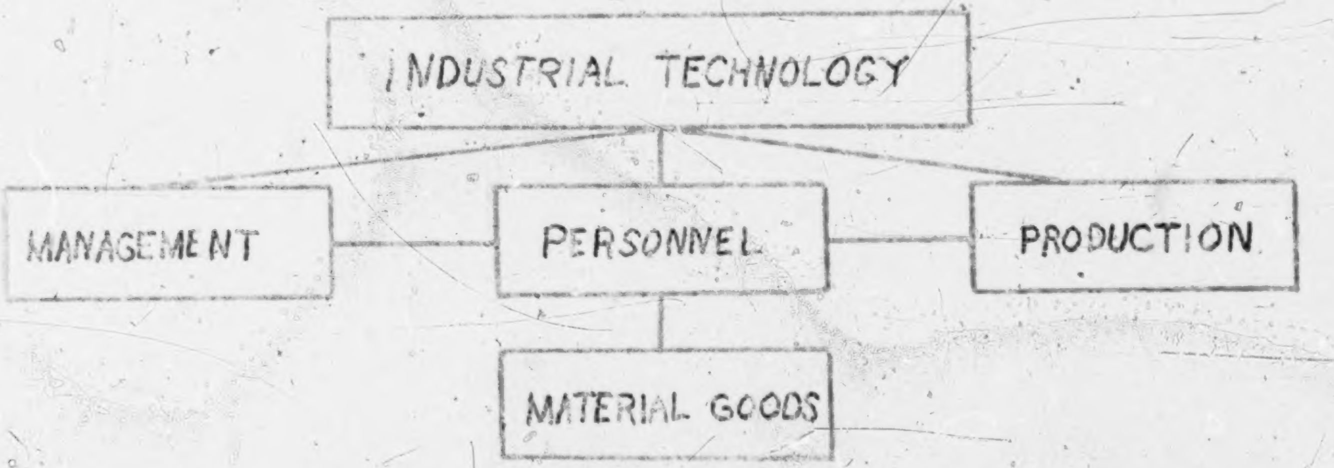


FIG. C MAKE UP OF INDUSTRIAL TECHNOLOGY

Many industries of today are very large and complex. One person cannot keep in touch with all parts of a large company. He is not able to understand all of its many operations. This makes it necessary to divide the company into departments. Each department is then responsible for a part of the work. These departments all work together to make up the company or industry.

Management. Management is concerned with planning, organizing, and controlling. Planning might include such things as determining the demand for a product, designing a product, and securing the raw materials to be used. The raw materials, labor, and machines are then organized to produce a finished product. Supervisors and foremen control the organization so that the raw materials flow through the plant to become finished products.

Personnel. Personnel is concerned with the hiring, training, working, advancing, and retiring of the workers. In working with people you run into many problems. "Labor" and "management" are still trying to solve these problems.

Production. Production is concerned with pre-processing, processing, and post-processing. Pre-processing would include the receiving and handling of the raw materials and making them available for processing. Processing includes the operations necessary to change the raw materials into the finished product. Post-processing would include the installing, maintaining, or repairing of the finished product.

It is not possible to draw lines of distinction between management, personnel and production. Their areas of responsibility continually overlap. All departments must "play ball", as members of a team, to give us the finished goods. Management plans and organizes the elements that make up industry. It then controls that plan and organization to make the product. Production makes the product and also is concerned with some areas of management. All through industry personnel is interested in how the worker reacts and behaves.

SPECIALIZATION LEADS TO MASS PRODUCTION

Years ago Henry Ford discovered that the more cars he built the more cars he could sell at a lower cost. And, the lower the cost of the cars, the more he sold. By selling at a lower cost more people were able to buy cars. As sales increased, he had to build more cars. By building more cars he was able to cut both costs and prices. This circle of events repeated itself many times. This helped the Ford Motor Company to grow to the size it is today.

As a company grows management learns to do things better. In learning to do things better many people become specialists (people who do one job). Some engineers, for example, give their full time to design. Others become expert in planning new machines or assembly lines. These operations are all necessary to make things better, faster, and at a lower cost.

There are materials specialists who look for the best and cheapest raw materials. Other specialists plan the manufacturing steps. Still others watch the worker as he works. They are looking for ways to make the work as easy as possible. Specialists have helped us get quantity production. This has become known as mass production.

INDUSTRIAL MATERIAL GOODS

Industry gives us material goods. Material goods are a result of our industrial know how. These goods are divided into two divisions: (1) constructed goods and (2) manufactured goods.

Constructed goods. These goods are usually built out in the open. Constructed goods include the construction of buildings, both private and public. Public utilities such as gas lines, power lines, railroads, and highways are listed as constructed goods.

Manufactured goods. These goods are most often made indoors. It is impossible to give a complete list of these goods. One government manual lists about 7,500 different items. You can think of many of these goods. A few of the main headings are: food products, textiles, wearing apparel, lumber, wood products, furniture, paper, chemicals, petroleum, rubber, leather, machinery, and transportation equipment. There are many other manufacturing industries in addition to the ones listed. (Fig. D).

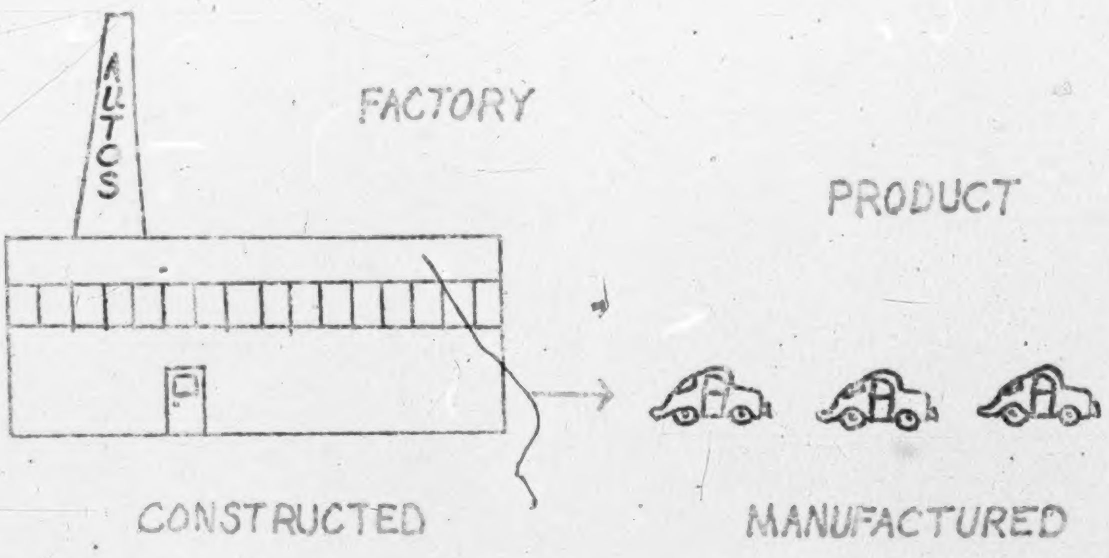


FIG. D

SUMMARY

In the introduction to industrial technology you have briefly looked at the make up of industry. This make up includes management, personnel, and production. When these three elements are put together with capital they produce manufactured goods.

Some people believe we are only at the beginning of technological progress. The next 100 years will bring many new discoveries. Discoveries that will have many benefits for human good.

As men once learned to use the power of steam, they are now finding the secrets of atomic power. They once made trial flights in aircraft that skimmed the grass. Now they send rockets into space and to other planets. As long as people are free to think, to experiment, and to exchange ideas, the industrial revolution will go on.

You are the future workers in a highly technical society. All too soon you will need to find some work you can do. Many of you will be training for jobs that are not now in existence. The future need is for people with a broad general knowledge of many things. The worker with a general knowledge will be able to change quickly to new positions. Get a good understanding of the basic elements of education. Be able to read and to write well so you may communicate clearly. Keep up your study of mathematics and science. If you will do all of these things, and do them well, you are on your way to success.

LABORATORY ACTIVITIES

Objectives. The student, after participating in the laboratory activity, will be able to:

1. Define the terms industry and technology.
2. Understand the industrial responsibilities of management, personnel, and production.

Activity #1 Questions.

1. What is the broad definition of the term industrial technology?
2. What kinds of activities are included in industry?
3. Explain the meaning of specialization of labor.
4. Why do designated people in a manufacturing plant spend so much time in studying movement of materials, location of tools, and routing of products?
5. What is management?
6. What is the chief task of management?
7. Define mass production and assembly line.
8. Name 5 products that we use in our everyday living which have been manufactured in mass production.
9. Name three industries which are considered big business.

Activity #2 Creative writing.

Consider inventions (past, present, and future) and write a short story. Start with something like the following.

We have no electric power and . . .

I lived before the invention of . . .

It is the year 2500 A.D. and I . . .

I stepped out of the time machine and . . .

Activity #3 Films on industry.

Why the Shoe Fits

Wonderland of Bread

MANUFACTURING TECHNOLOGY

OBJECTIVES

The student will be able to:

1. Explain or define the idea of manufacturing technology.
2. Recognize the major historical events concerning manufacturing technology.
3. Recognize the place of manufacturing technology in the world today as it bears on people and the material goods they produce.
4. Recognize the importance of manufacturing technology in the future.
5. State clearly the three basic elements of manufacturing technology and define the purpose of each.

INTRODUCTION

You have learned that manufacturing along with construction make up industry. You have also learned that industry is one way of making materials to satisfy our every day needs. Industry, along with mining and farming give us most of the things we use. In this unit, we will take a closer look at manufacturing. Manufacturing technology, as a way of changing the form of material, will be defined. We will also look at the history of manufacturing. The importance of manufacturing in the world of today and tomorrow's world will be presented. Management, production and personnel, as divisions of manufacturing, will be described.

MANUFACTURING TECHNOLOGY

Manufacturing technology (tek-nol'-o-ji) is a way of changing the shape or form of materials to satisfy our everyday needs. Manufacturing can be done in a small shop. It can be done in a factory or large plant. The changing of the shape or form is called processing. The materials put into processing are known as input. Products are the output of manufacturing processing. (Fig. A).

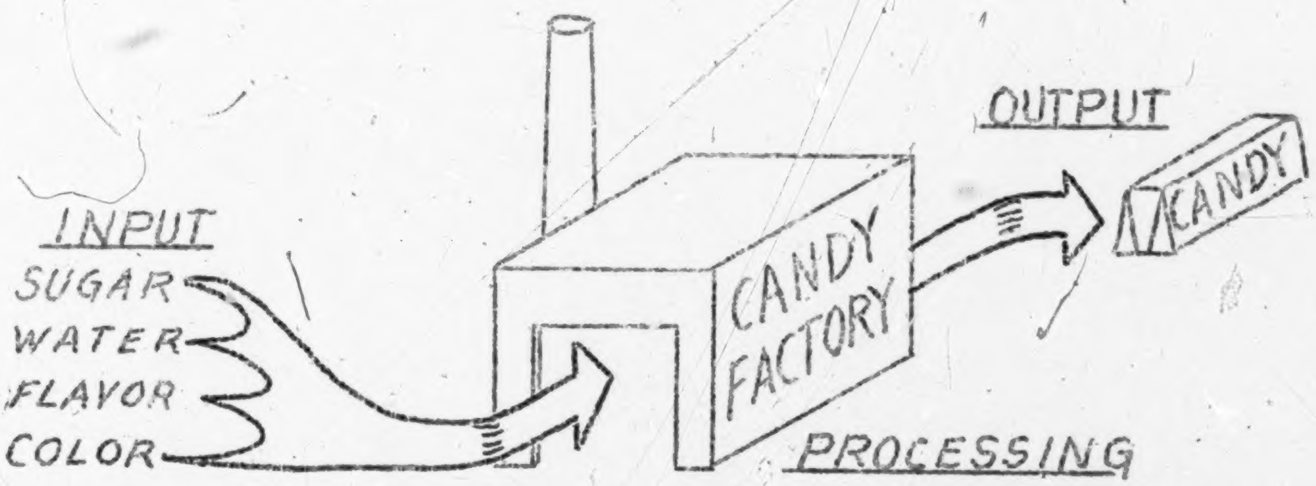


FIG. A. Manufacturing Technology

Manufactured goods (the result of the input-processing output idea) may be divided in several ways. That is durable and non-durable goods. They also may be thought of as being light and heavy. Durable products are those that last a long time. Non-durable products are those that are used up quickly. A shirt that you wear is a light durable product. A car is a heavy durable product. Candy is a light non-durable product.

Manufactured goods can also be divided into consumer goods and producer goods. Consumer goods are used by people directly. Producer goods are used by other manufacturers to make their products. Car manufacturers buy tires from the tire manufacturers. The tire is then considered producer goods. When we buy the car with its tires, the car is considered consumer goods.

HISTORY OF MANUFACTURING TECHNOLOGY IN AMERICA

Manufacturing in America began to grow during the Revolutionary War. During the war, the English no longer sent goods to the colonists. This forced the colonists to make their own things.

Eli Whitney, the inventor of the cotton gin, in the late 1700's introduced the idea of making guns by mass production. This idea gave America its first burst of manufacturing.

Manufacturing in the United States dropped during the early 1800's. At this time, England sent a great deal of goods to the United States. During the Civil War there was a great need for war materials. This caused manufacturing in the United States to rise. (Fig. B).

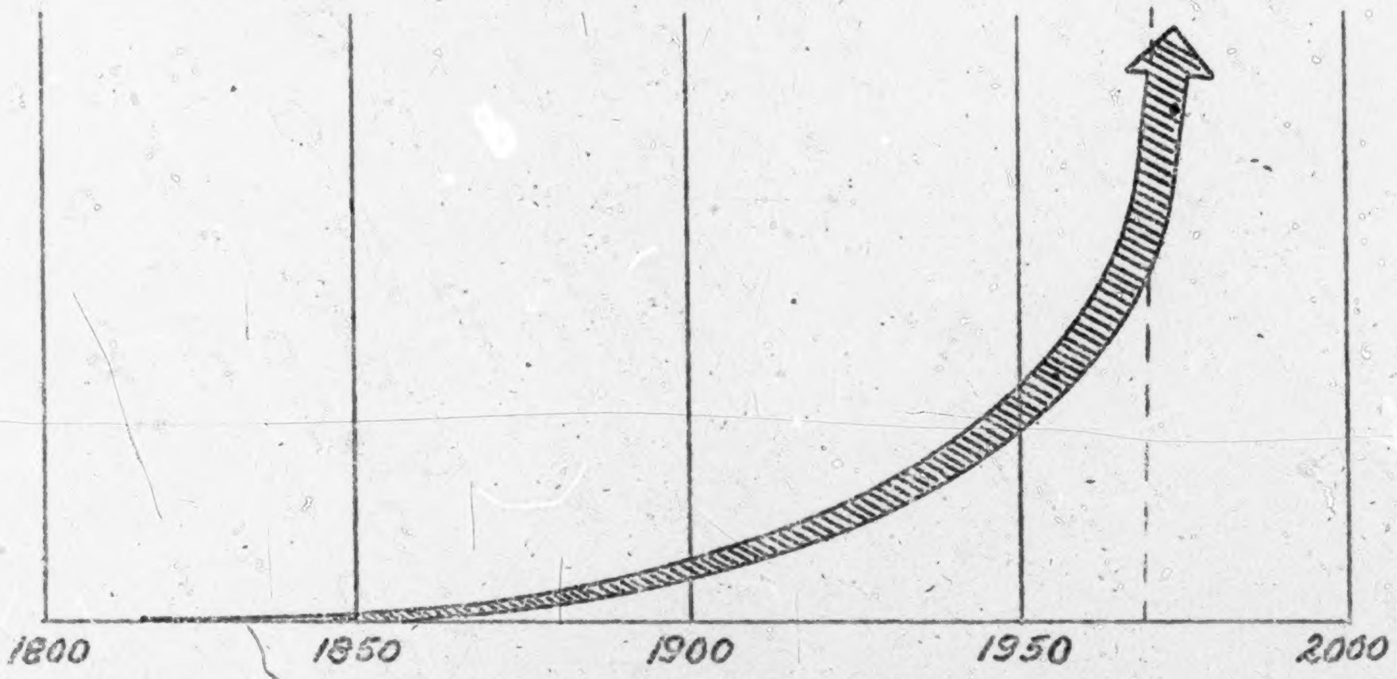


FIG. B. Growth of Manufacturing

Manufacturing is usually found near places that have enough natural resources, good transportation, mild climates and large populations. In the United States, most of the manufacturing takes place in the northeastern quarter of the country. (Fig. C). New York State leads all the states in manufacturing.

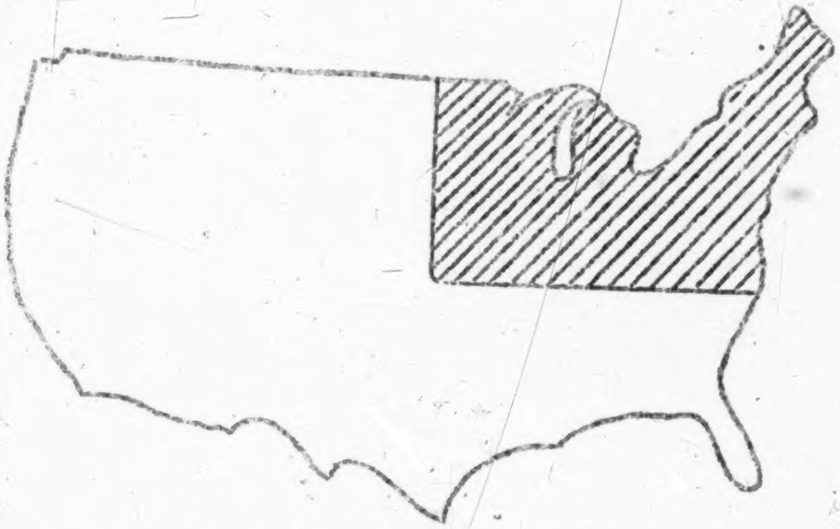


FIG. C. Most Manufacturing in the United States Takes Place in the Northeast

MANUFACTURING OF TOMORROW

All manufacturing in the United States will change. This will be due to new machines, better ways of making goods and new materials. The makers of steel and aluminum, electric machinery, cloth and chemicals will see the most change. This change will be due to more competition from other countries and newer and better materials. Change will also come as we learn better ways of making products.

Automation (automatic machines) along with computers (machines that handle information with amazing speed) will be used in manufacturing. Automatic controls and handling machines will be used more. All of these new machines will make a difference in manufacturing.

Employment in manufacturing will rise. The need for manual labor will decrease. This will be true as new ways of manufacturing are discovered. This means that there will be fewer jobs for people with little skill. More of man's work will be done by machines.

There will be more need to know about many fields of work. There will be a need for a broad education and training as a preparation for work. This also means that the worker needs to be ready for change during his working years. The youngsters in the sixth grade of today are preparing for jobs, half of which don't even exist today. (Fig. D).

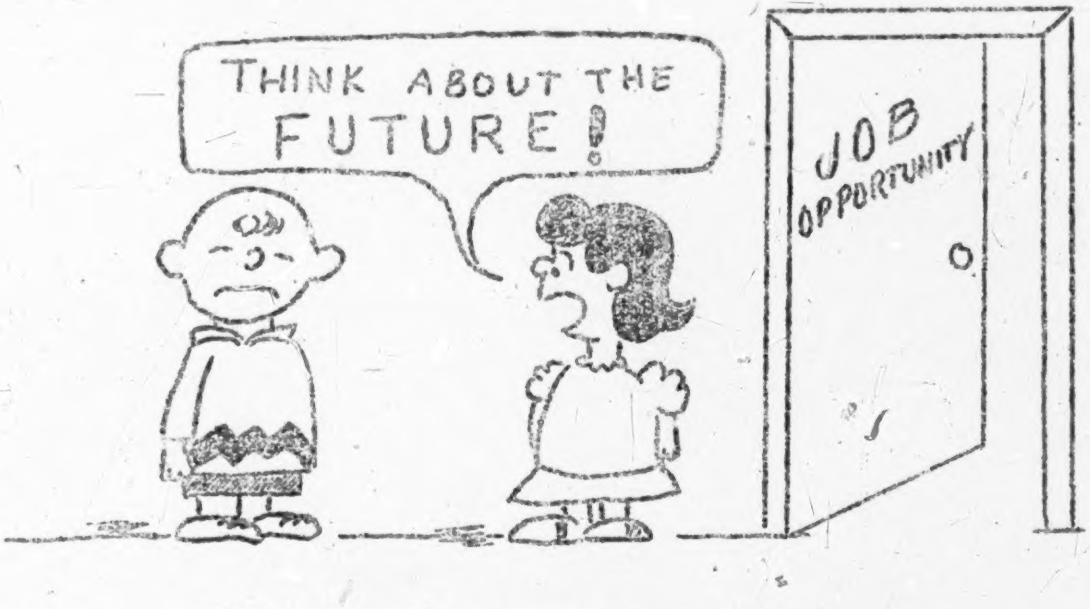


FIG. D. What's your Future?

ELEMENTS OF MANUFACTURING TECHNOLOGY

Manufacturing technology includes three elements (divisions). The three elements of manufacturing are: (1) management; (2) production; (3) personnel. There are no sharp lines that separate these elements of management. They combine their efforts many times. For an example, Personnel, (working with people) is very important to both management and production. It is people that make them both operate.

Management. Management can be described as that part of manufacturing that plans, organizes and controls people and materials in the production process. Process is a way of doing something.

Management is an important part in the making of a product. An airplane needs all phases of management to get it off the ground. What the airplane should be able to do, how it should look, and how it should be made are all the duties of management.

Management is responsible for organizing the plant. It also secures the materials, machines, money and workers needed to build the airplane. Management is also responsible for the final product. They must control the material and humans who build the airplane so that it comes out as it was intended.

Production. The goal of manufacturing technology is production. The responsibility of production is to produce the product. The three parts of production are: (1) pre-processing; (2) processing; (3) post-processing.

1. Pre-processing. Production is responsible for the receiving, unpackaging, handling, storing and protecting the materials. Aluminum, the metal used in airplanes, must go through this part of production. Care must be taken not to damage the aluminum.

2. Processing. Production is responsible for making the product. It makes the parts. It assembles (puts together) the parts to make the finished product. The airplane is made up of many thousands of parts. The parts of an airplane must fit together exactly. Many lives and dollars depend on how well the parts are made and how well they are put together.

3. Post-processing. Another duty of production is the installing, maintaining, reparing and sometimes changing the product after it has been produced. On a large product such as an airplane, the company that manufactures the airplane will send a crew of men with the airplane. They will check it out and make the needed changes.

Personnel. A very important partner on the manufacturing technology team is Personnel (Per'so-nel). Personnel is responsible for hiring, training, working conditions, advancing and retiring of people that work in manufacturing. Personnel not only provides people to work in production, but also management. Their task is a large one. For instance, selecting an airplane designer would be much different than hiring a worker who assembles parts.

It is clear that manufacturing technology is very complex. We shall learn more about manufacturing as we study its many parts. It should prove to be very challenging and rewarding.

SUMMARY

Manufacturing technology is a way of changing the shape or form of materials to satisfy our everyday needs. This means putting materials into processing, and then coming out with a product we can use. Manufactured goods can be durable or non-durable. They may be consumer or producer goods. Manufacturing had its beginnings during the Revolutionary War. The Civil War and World War I gave America the leadership in manufacturing. Manufacturing employs about one fourth of our working people. As manufacturing changes, so will the people who work have to change. The challenge for tomorrow is great.

Management includes three elements. The three elements are management, production and personnel. Management plans, organizes and controls humans and material in the production process. Production actually produces the product. The three elements of production are pre-processing, processing and post-processing. Personnel is responsible for the hiring, training, working conditions, advancing and retiring of people that work in manufacturing.

LABORATORY ACTIVITY

Objectives. The student will:

1. Make a folded paper airplane by two methods:
    a. As an individual
    b. With a group by mass production
2. Will compare the two methods of making the airplane in terms of:
    a. The number of planes made
    b. The quality of the airplanes
    c. The ease of making the airplanes
3. Express their opinions as to the merit of each method.

Introduction. In this activity we will manufacture folded paper airplanes. The teacher will first demonstrate how to fold the airplane. You will then have a chance to practice folding one yourself. We will then begin to manufacture the airplane.

The first time you will make as many as you can in 8 minutes. At the end of 8 minutes the completed airplanes will be collected. Then we will divide the class into 3 groups. You will be a member of one of the groups. The groups will meet for 10 minutes to decide how the work will be divided. At the end of 10 minutes, each group will be given materials and equipment. The groups will then begin production. You will be allowed 8 minutes. At the end of 8 minutes, all the completed airplanes will be collected.

We will then compare the two ways of manufacturing. We will also draw some conclusions as to the merit of each method.

Materials

1 ream - $8\frac{1}{2}$" x 11" duplicator paper (three colors)

Equipment

24 - scissors

24 - wing and tail templates

2 - boxes paper clips

Activity

Phase I - Demonstration and practice

1. The teacher will demonstrate how to fold the airplane. (Fig. E).

2. You will fold one practice airplane.

Phase II - Individual manufacturing

1. You will fold as many airplanes as you can in 8 minutes.

2. At the end of 8 minutes you will stop and all of your completed airplanes will be collected.

Phase III - Mass production

1. The teacher will select 3 managers.

2. The managers will choose workers for his section.

3. You and your section will meet for 10 minutes to decide how the work will be divided.

4. After 10 minutes, your section will be seated in a group.

5. Each group will receive the necessary materials and equipment. Each section will have its own colored paper.

6. You will begin production and work for 8 minutes.

7. After 8 minutes, your section will stop and all the completed airplanes will be collected.

Phase IV - Conclusions

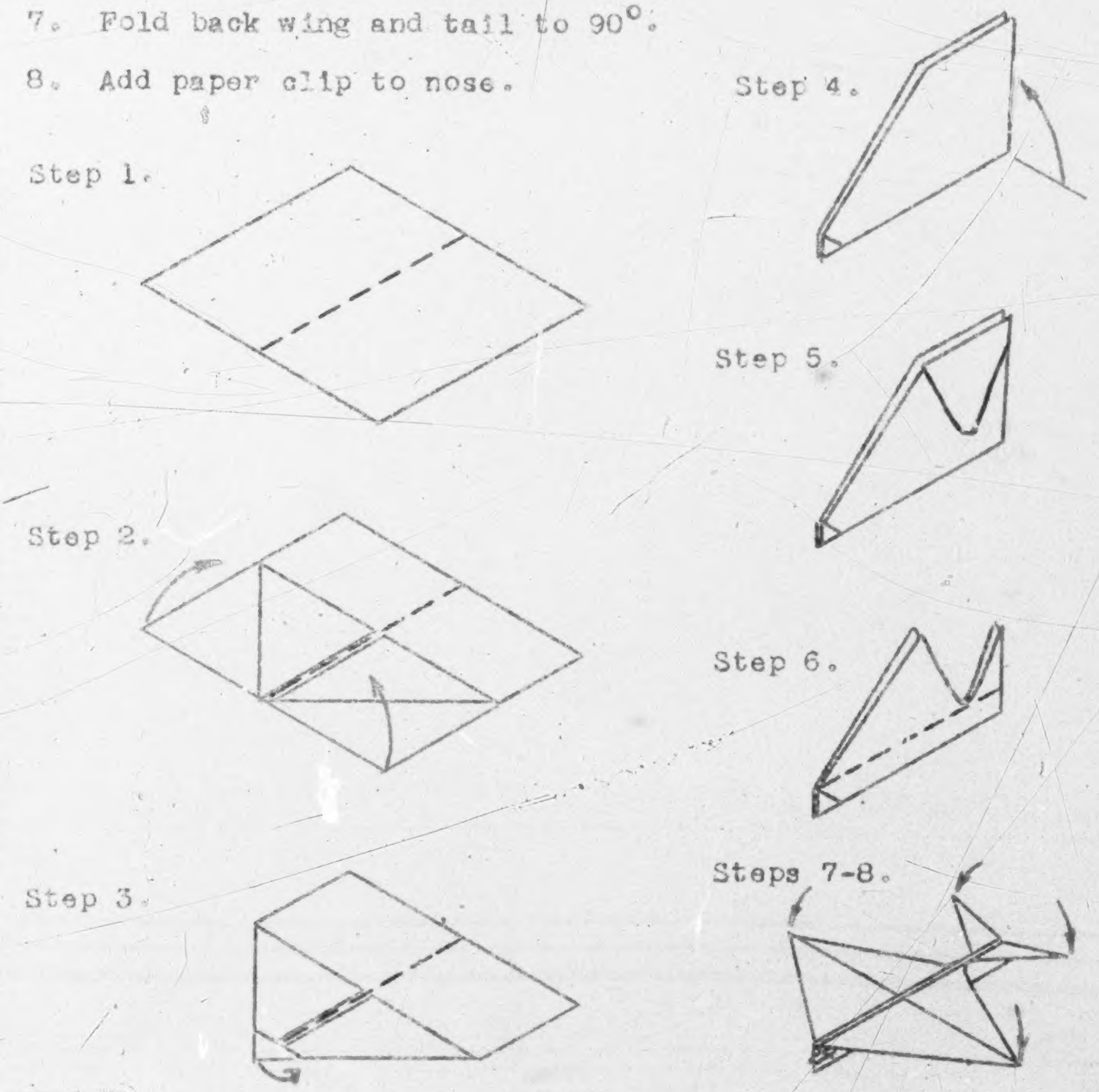
1. Make a comparison of the two ways of manufacturing on the basis of:

   a. number of airplanes completed.
   b. quality of the completed airplanes
   c. ease of making the airplanes

2. Make some conclusions concerning the two ways of manufacturing.

PROCEDURE:

1. Fold paper in half width-wise.
2. Fold two corners to 45° angle.
3. Fold the point down, 3/4" from point.
4. Bring wings and tail up.
5. Draw outline of wings and tail with the template.
6. Cut out wings and tail on lines.
7. Fold back wing and tail to 90°.
8. Add paper clip to nose.


Step 1.

Step 2.

Step 3.

Step 4.

Step 5.

Step 6.

Steps 7-8.

FIG. E. How to Fold a Paper Airplane

HIRING

OBJECTIVES

The student, by studying this unit, should be able to identify the personnel practices for:

1. Recruiting: (sources for employees, vacancy notices, and personal contacts).
2. Selecting people: (screening, testing, interviewing, and physical examinations).
3. Inducting people: (orientation, records, and follow-up).

INTRODUCTION

Today, modern industry may have new machines, equipment, controls and systems. People, however, still remain the most important factor in manufacturing. People still determine if the company makes a good product. People still determine the success of a company. All of these people are a part of the companies personnel.

The personnel department's job is to produce this winning team. This success depends on knowledge and techniques used by this department. To insure an effective working force, personnel should follow these six steps:

1. Define the job.
2. Select the man.
3. Train him.
4. Help him.
5. Provide a successful atmosphere.
6. Let him know how he is doing.

These steps are not unusual. The New York Mets followed them when forming their team. A Hollywood producer would go through them to make a movie. So should management when organizing a team for production. Success comes when the worker is encouraged in each step. Let us see how the manufacturing industry would follow similar steps when hiring people.

RECRUITING

Sources for Employees. The personnel department must always maintain a supply of recruits. There are two places to get this supply:

1. From within the organization.
2. From outside the organization.

Most large industries usually try to promote from within. Jobs which are high level type or require skill usually come from within. This helps the moral of the workers. They feel there is a possibility for promotion. If personnel cannot find someone, then they go outside.

Normally, people recruited from outside the organization are for unskilled or semi-skilled jobs. They are considered low level positions. With increased technology, these jobs are being eliminated. This is why it is important to continue your education.

Vacancy Notices. There are several ways to let people know of job vacancies. The job must be posted on the bulletin board in factories that have unions. Non-union factories or small shops usually do the same. They do not have to. Again, this helps to keep employees happy.

Advertisements in newspapers, journals or magazines are methods to notify people outside the organization. Jobs are usually placed in newspapers under the Help Wanted section. It gives all pertinent information about the job. A typical ad could be a few lines or a whole page. (Fig. A). Trade journals and magazines are usually used to advertise for engineering jobs.

Maintenance Electrician
and
Mechanical Repairman
With fringe benefits
Ohio Malleable Division
Dayton Malleable Iron Co.
Call Frank Lehman,
AX-L-5635

FIG. A. Typical Ad found in Help Wanted section of newspaper.

Employment agencies are another source to recruit people. The state agency is a good source for unskilled or semi-skilled persons. Private agencies advertise with no cost to the employer. The fee is paid by the worker seeking employment. It usually is the first two weeks of his pay.

Schools are another source where vacancies are posted. Public schools can supply unskilled, but potential workers. Trade schools can offer semi-skilled workers. Technical schools may furnish semi-skilled workers or technicians for laboratories. Colleges and universities are good sources, especially for engineering students. In fact, large companies tend to hire talented graduates just before they receive degrees. They may have to bid to get them to sign a contract. The labor market needs people with engineering or technical training. Again, prepare yourself for the future with a sound education.

Personal Contacts. Friends of employees have been found to be a good source for workers. This is very true for small plants or shops. Employees usually only recommend friends who they know are good workers. (Fig. B). Small plants seldom advertise for help because of this. This has been a reliable source for their needs.

Large companies may rely on gate hiring. (Fig. C). People go to the gate and may be hired immediately if a worker is needed. News of this hiring spreads by the grape vine. Many other workers can then be recruited. This method is used if a large quantity of unskilled workers are needed.

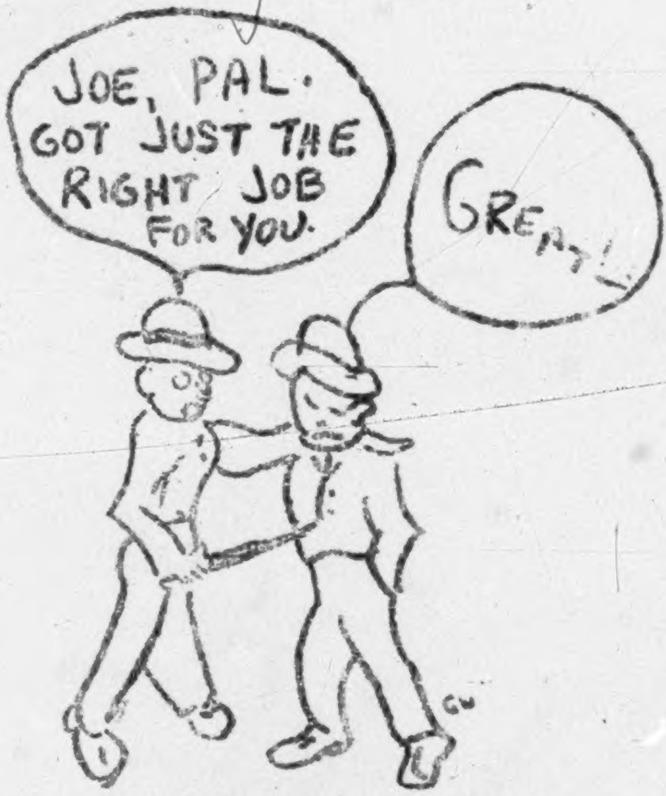

JOE, PAL. GOT JUST THE RIGHT JOB FOR YOU.
GREAT!
GW

FIG. B. Friend to Friend Contact.

Companies may phone other companies to hire their unemployed workers. This is usually not satisfactory, but is a source. High level executives or technicians can usually be found this way. It

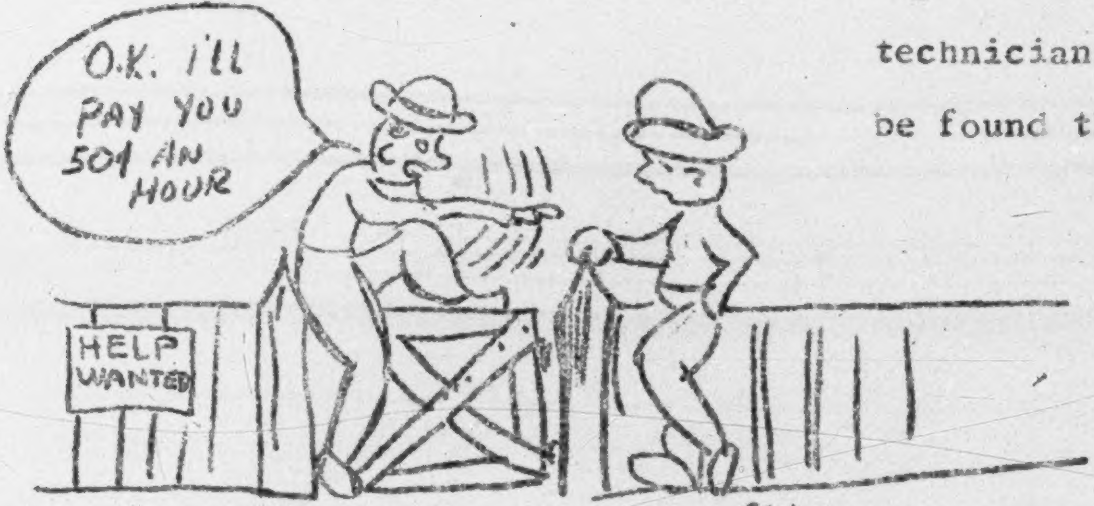

O.K. I'll PAY YOU 50¢ AN HOUR
HELP WANTED
G.W.

FIG. C. Gate Hiring

takes time, but has the advantage over the other methods. This personal phone call is more convincing and human to the creative person. (Fig. D).

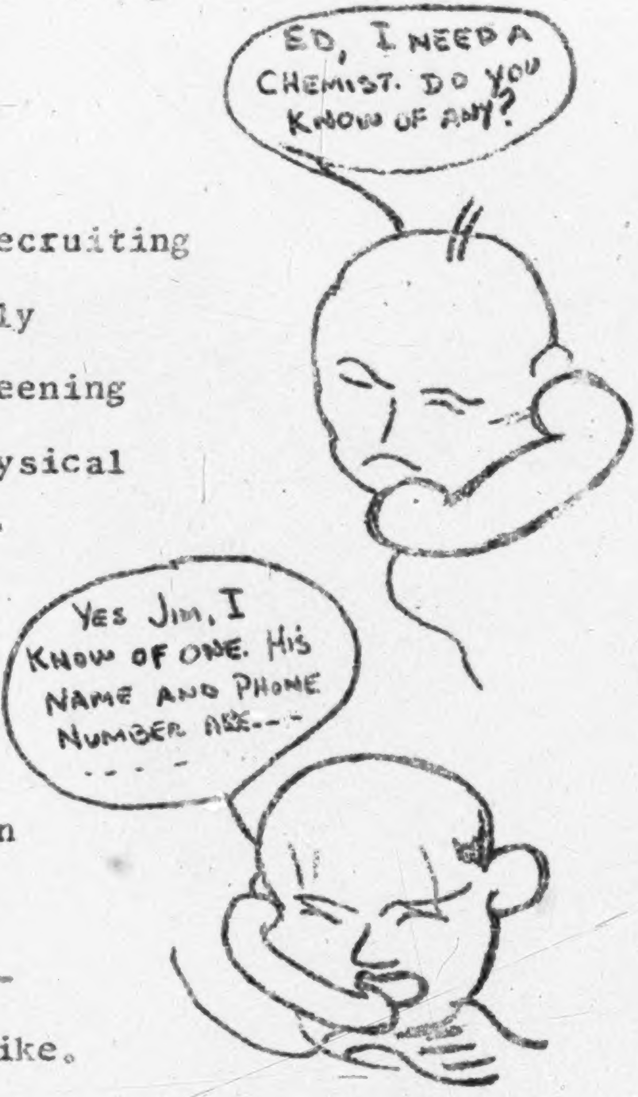

ED, I NEED A CHEMIST. DO YOU KNOW OF ANY?
YES JIM, I KNOW OF ONE. HIS NAME AND PHONE NUMBER ARE-- - - - - -

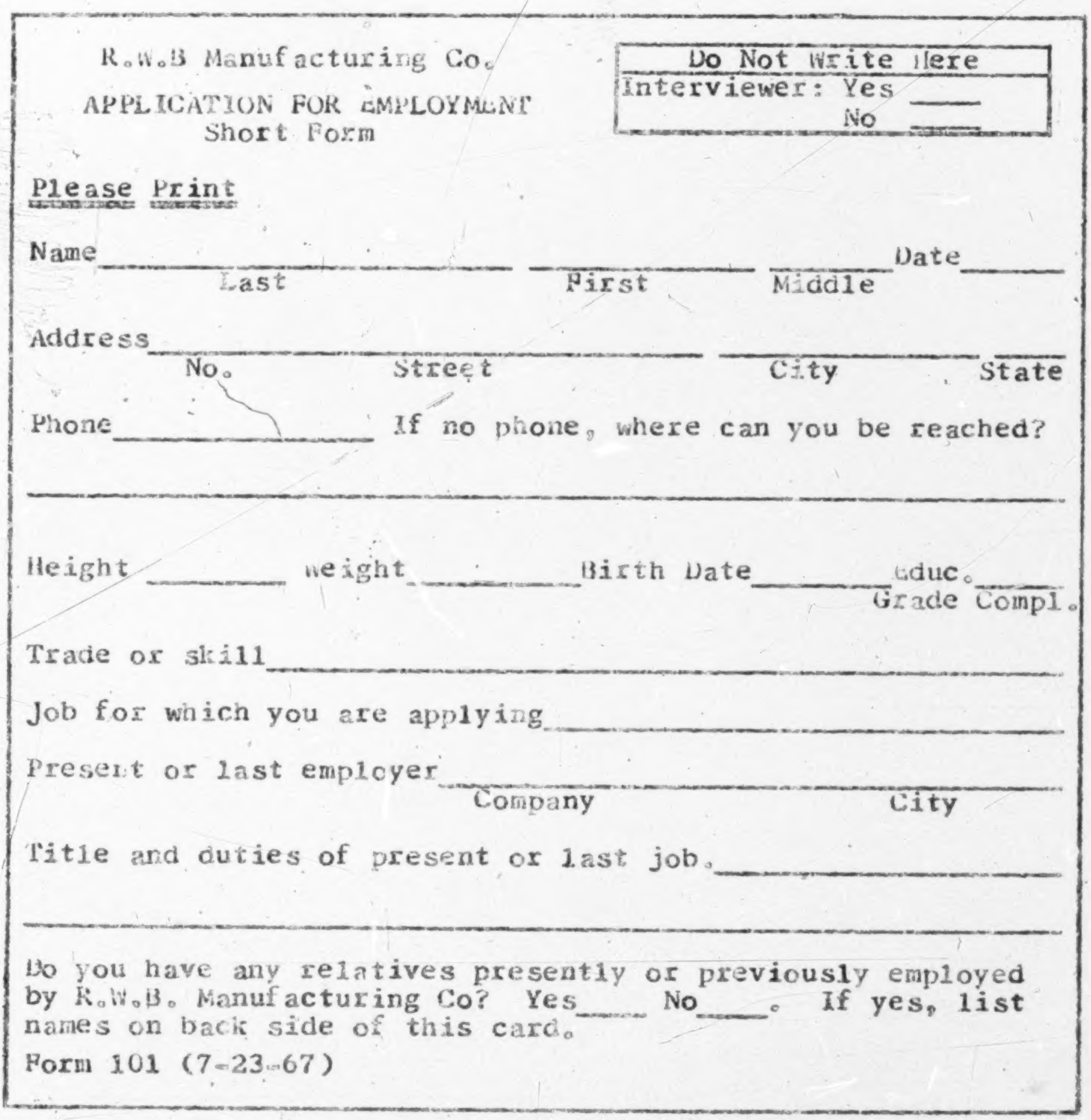
FIG. D. Company-to-Company

SELECTING

Screening of applicants. If recruiting was successful, the sources of supply must then be screened. Initial screening can eliminate those with obvious physical disorders. Those who pass basic standards fill in an application blank. This is the most common form used. (Fig. E). It provides the company with all the information needed for the interview. Different jobs will require different information or forms. They are not all alike.

References given on the form are then checked. This can be done by the telephone, letter or a personal visit. (Fig. F). The type of job will determine the method.

Testing. A series of tests can be used to find the applicant's ability. There are five general types: (1) vocational, (2) mental ability and aptitude, (3) skills and performance, (4) personality and temperament, and (5) attitudes. Again, the type of job will determine the tests taken. Sometimes none, one, two or all of them may be required. (Fig. G).



R.W.B Manufacturing Co.

APPLICATION FOR EMPLOYMENT
Short Form

Do Not Write Here
Interviewer: Yes ____ No ____

Please Print

Name ______________ ______________ ______________ Date ______
Last First Middle

Address ______________ ______________ ______________
No. Street City State

Phone ______________ If no phone, where can you be reached?

____

Height ________ Weight ________ Birth Date ________ Educ. ____
Grade Compl.

Trade or skill ______________________________

Job for which you are applying ______________________________

Present or last employer ______________________________
Company City

Title and duties of present or last job. ______________________________

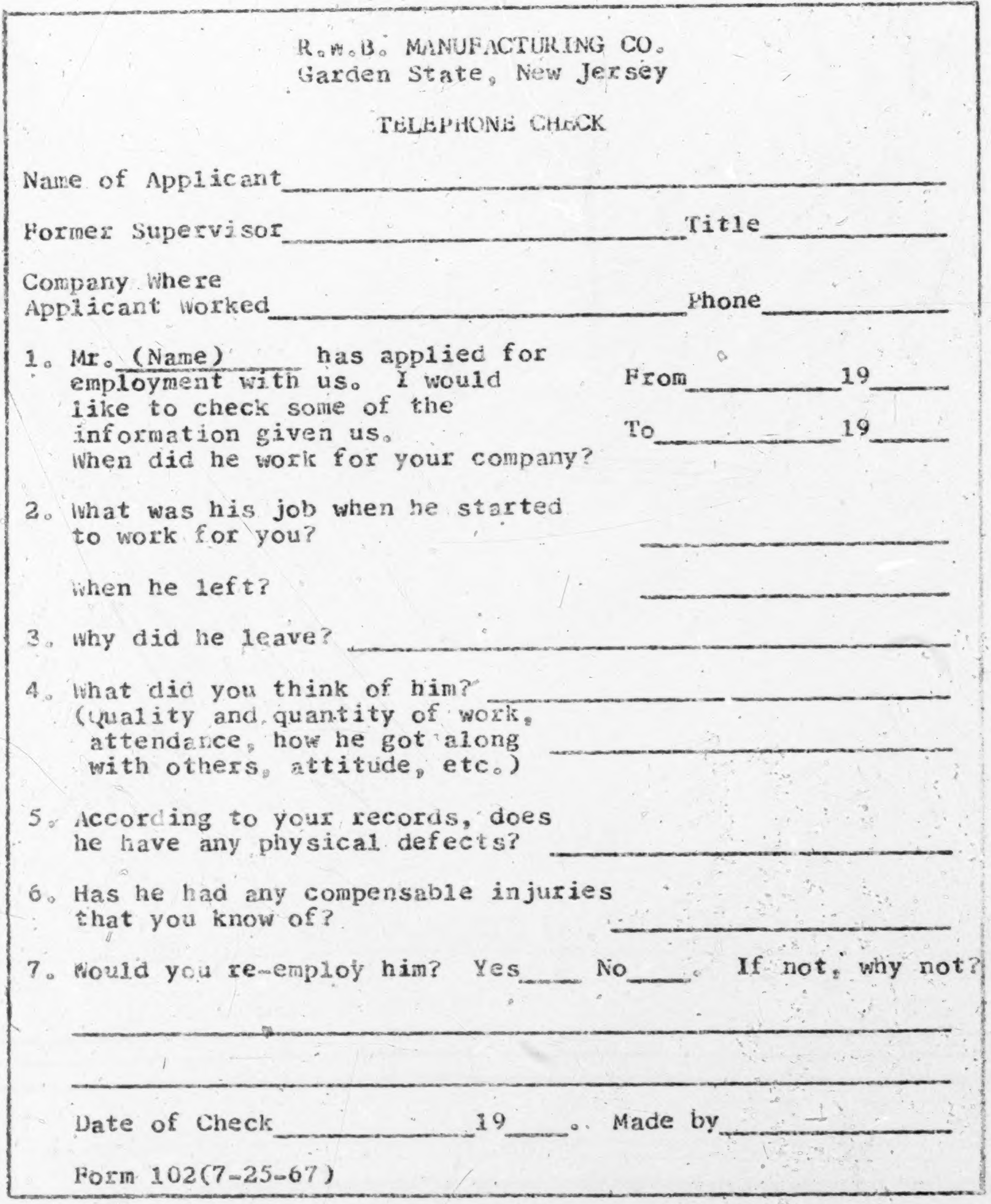
____

Do you have any relatives presently or previously employed by R.W.B. Manufacturing Co? Yes____ No____. If yes, list names on back side of this card.

Form 101 (7-23-67)

FIG. 4. Preliminary Application Blank for the R.W.B. Manufacturing Company. Enough information is obtained on this short form for the interviewer to make a preliminary judgement about the applicant. If judgement is favorable, the selection process is continued. If not, both parties saved time.

4:7



R.W.B. MANUFACTURING CO.
Garden State, New Jersey

TELEPHONE CHECK

Name of Applicant________________________________

Former Supervisor____________________Title__________

Company Where
Applicant Worked____________________Phone__________

1. Mr. (Name) has applied for employment with us. I would like to check some of the information given us. When did he work for your company? From________19____ To________19____

2. What was his job when he started to work for you? ________________

   When he left? ________________

3. Why did he leave? ________________________

4. What did you think of him? ____________________
   (Quality and quantity of work, attendance, how he got along with others, attitude, etc.) ____________________

5. According to your records, does he have any physical defects? ____________________

6. Has he had any compensable injuries that you know of? ________________

7. Would you re-employ him? Yes____ No____. If not, why not?

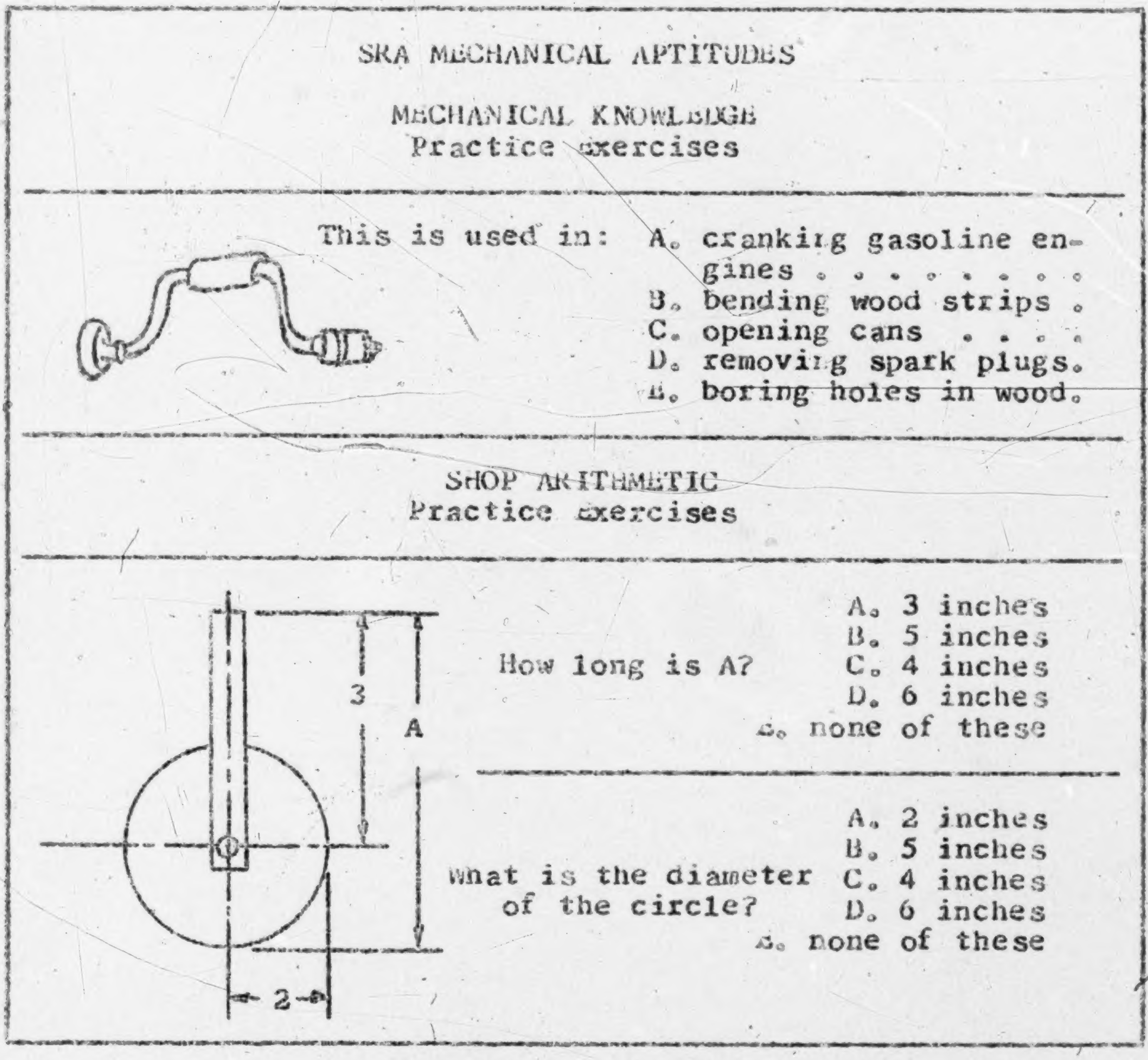
____

____

Date of Check__________19____. Made by____________

Form 102(7-25-67)

FIG. F. A Telephone Check Sheet used to confirm applicant's previous record. This oral check is preferred over the written because it is faster, and more frank with complete answers given.



SRA MECHANICAL APTITUDES

MECHANICAL KNOWLEDGE
Practice exercises

This is used in:
A. cranking gasoline engines . . . .
B. bending wood strips .
C. opening cans . . . .
D. removing spark plugs.
E. boring holes in wood.

SHOP ARITHMETIC
Practice exercises

How long is A?
A. 3 inches
B. 5 inches
C. 4 inches
D. 6 inches
E. none of these

What is the diameter of the circle?
A. 2 inches
B. 5 inches
C. 4 inches
D. 6 inches
E. none of these

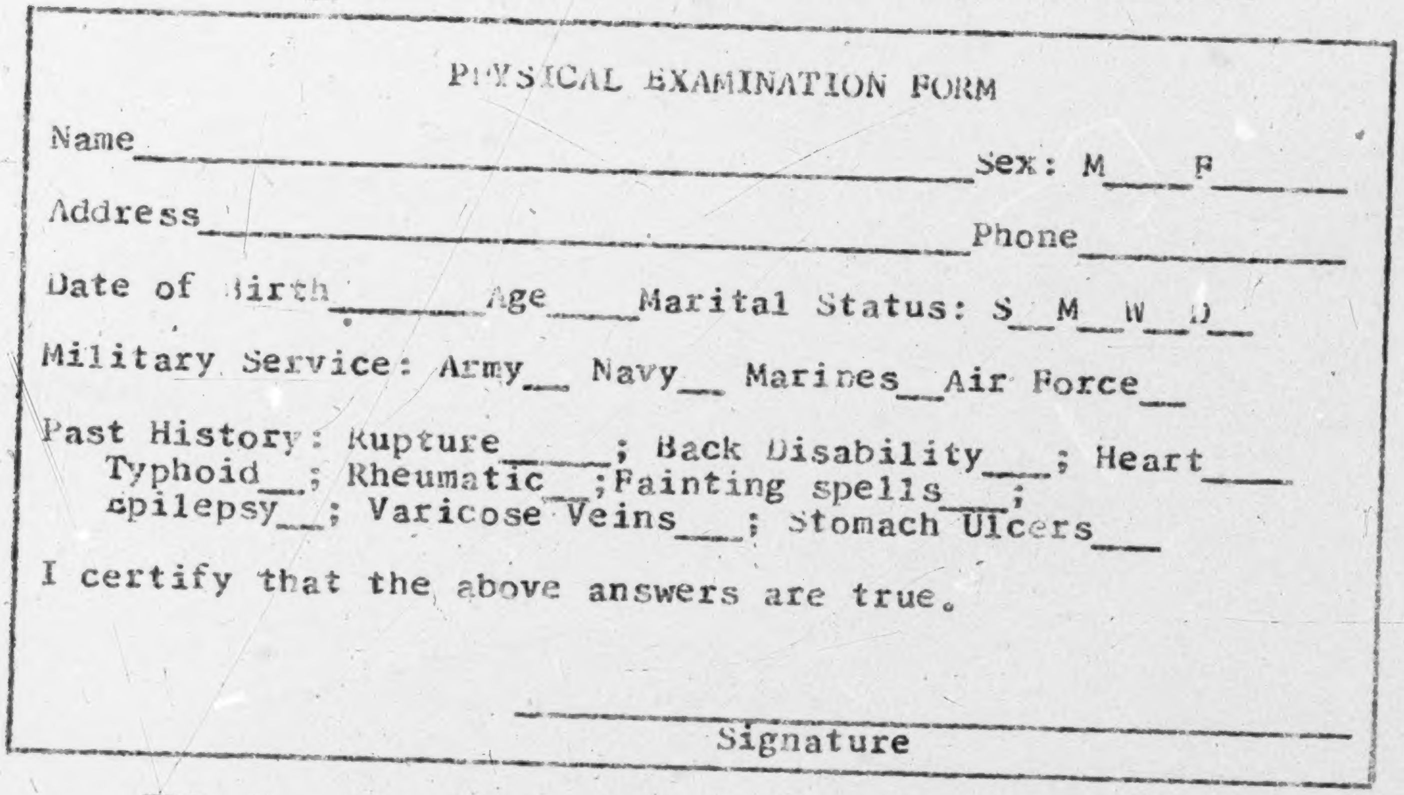
FIG. G. SRA Mechanical Aptitudes is a test to measure your mechanical ability in Mechanical Knowledge and Shop Arithmetic.

The Interview. The interview is an important part in the decision-making process. This is the most crucial point of hiring a person. The interviewer must be well prepared for this applicant. He can insure this success by:

1. Providing privacy during the interview.
2. Having a comfortable room and setting.

3. Having all important data available.
4. Having a good attitude towards the applicant.
5. Being able to handle resistance in the applicant.
6. Concluding the interview so the applicant leaves satisfied.

Physical Examinations. The pre-employment physical examinations are very important to the company. It provides a picture of the applicant's health. (Fig. H). It will protect the applicant from taking a hazardous job. It reduces time lost because of sickness. It protects the other workers against communicable diseases. The company's record is guarded under the workmen's compensation law.



PHYSICAL EXAMINATION FORM

Name____Sex: M____F______

Address_____________________________________Phone__________

Date of Birth_______Age____Marital Status: S__M__W__D__

Military Service: Army__ Navy__ Marines__Air Force__

Past History: Rupture_____; Back Disability___; Heart____ Typhoid__; Rheumatic__;Fainting spells___; Epilepsy__; Varicose Veins___; Stomach Ulcers___

I certify that the above answers are true.

____
Signature

FIG. H. Example of Physical Examination Form Used for pre-employment.

If possible, the physical should be taken before the interview. The company's limited medical facilities normally makes this immpossible. However, the physical should be taken before hiring the worker.

INDUCTING

Orientation. Once the employee has been selected, he has to be inducted. He will be told the company's expectations. Also, what he may expect from the company. He should be welcomed to his working group. Information as to working hours, pay days, vacations, holidays, and the like should also be given. He should also be told of all company regulations. (Fig. I).

ORIENTATION ATTENDANCE REQUEST		FORD MOTOR COMPANY
Name of Employee		Date
Place of Meeting	Time of Meeting	Date of Meeting

To the Supervisor:

We believe that an informed employee is a more satisfied employee. Therefore, we ask for your cooperation to help us better acquaint our new employees with the policies of the Company.

May we request that the above report at the time and place indicated to attend a meeting of new employees.

Salaried Personnel Placement
Industrial Relations

FIG. I. An Orientation Request Form sample.

Records. Personnel forms which require additional information of the employee should be filled out now. These could be personal record forms, social security forms, payroll deductions, hospitalization, and the like. This information should be distributed to the appropriate departments.

Follow-up. A well planned induction should check if the worker fits in the group. The follow-up interview should answer all pending questions. Misconceptions or misunderstandings should be corrected.

The day-to-day work performance should be checked during the probationary period. A systematic effort should be made so the worker becomes an efficient employee. He should be a satisfied worker on this successful personnel team that makes up the manufacturing industry.

SUMMARY

People are still the most important element of industry. Efficient hiring procedures will insure a more productive industry. A good source of workers should be maintained through recruiting efforts. Selecting qualified people with good interviewing procedures is the key to hiring. Once accepted, the applicant should be oriented to his new job. His performance should be evaluated and appraised day-to-day. A friendly atmosphere provided for the worker should gain full production. This total team approach should provide one step towards a successful industry.

LABORATORY ACTIVITIES

Objectives.

The student, after participating in the laboratory activities, will enable him to:

1. Write job descriptions for a vacancy.
2. Fill out an application form for a job.
3. Take a skills and performance test.
4. Fill out a personnel information form.

Materials.

1. 5" x 8" Index Cards.
2. #2 pencil/eraser.
3. Application Forms.
4. Personnel Record Forms.
5. Review Questions.

Equipment.

1. Hand-Tool Dexterity Test. Complete with bolts, 8" adjustable crescent wrench, 6" screwdriver, 13/16" open-end wrench, 7/16" open-end wrench.
2. Official's Stop Watch.

Activity #1. Questions

1. Name at least five types of jobs for which you most likely would hire from outside the company?
2. Which method of recruiting would you use if you needed 25 parts packers in two days? Explain.
3. Which test or tests would you give to a person being hired as a machinist? Why?
4. Name some things you would do to make a worker enjoy his job?
5. Name four different types of schools vacancy notices may be posted?

Activity #2. Job Description Exercise

The student is to write important job information on a 5" x 8" Index Card. This will be used to advertise a vacancy for a job that will be needed later in the manufacturing of a product in class.

The information should include the name of the job, quantity required, experience, salary, benefits, person to contact, phone number, name and address of company.

Activity #3. Application Form

The student will fill in an application form. (Fig. J). It is important that this form should be done neatly and instructions followed carefully. This is the first impression the employer will have of your ability. It has been known that people lost the job because of sloppiness. Print clearly.

EMPLOYMENT APPLICATION

Name ______________________________ Date __________
Last   First

Address ______________________________ Phone __________

Birth Date ____________ Age ______ Grade ______ H.R. ______

Job applied for ______________________________

Activities: In school ______________________________

Outside of school ______________________________

FIG. J. Sample Application Form to be used by the student when applying for manufacturing job.

Activity #4. Hand-Tool Dexterity Test

This test will measure your ability to use a wrench and screwdriver. The four bolts of three different sizes mounted on one side of the U-shaped frame are to be removed in an orderly fashion with the tools supplied. The nuts, washers and bolts are to be reassembled on the opposite upright. (Fig. K).

The score is the time required to do the task. Work in pairs, one keep time while the other does the task. Try to be accurate.

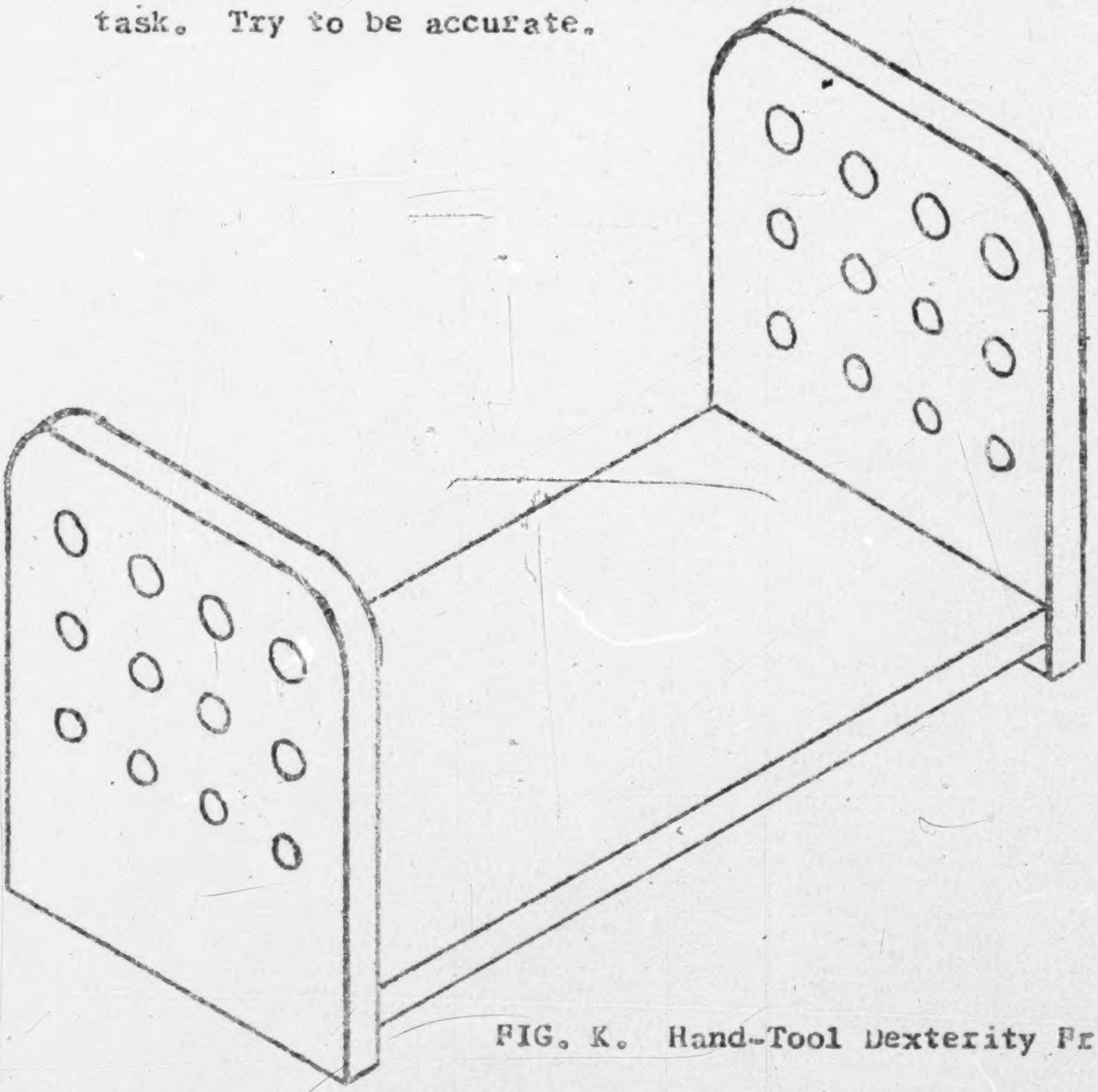


FIG. K. Hand-Tool Dexterity Frame

Activity #5. Personnel Record Form

This form is a permanent record for the company. The form you will fill in is your junior high school Industrial Arts Permanent Record form. (Fig. L). Please fill in all information. Print neatly and accurately.

Industrial Arts Department
STUDENT PERMANENT RECORD

Name ____________________ ____________________ Date ________
Last First

Address ____________________ Phone ____________

Date of Birth ____________________ Age ____ Grade ____________

Homeroom Teacher ____________________ H.R. No. __________

Elementary School Attended ____________________

Parent's Occupation ____________________
(or Guardian's)
Place of Employment ____________________

School Activities:	Hobbies:
1.	1.
2.	2.
3.	3.

Do Not Fill in Below

Student's	Personal Qualities:
Bench No. ____________	Attitude _____, Initiative _____
Goggles ____________	Behavior _____, Dependable _____
Text Book ____________	Cooper. _____, Integrity _____

Tests:	Quant. of Work - Qual. of Work
1. _____ 2. _____ 3. _____	1. ____________ ____________
4. _____ 5. _____ 6. _____	2. ____________ ____________

Marking Period Grades: 1. __ 2. __ 3. __ 4. __ Final Aver. __________

FIG. L. A sample Permanent Record Form

BIBLIOGRAPHY

Amrine, Harold, Ritchey, John A. and Hulley, Oliver S. Manufacturing Organization and Management. Englewood Cliffs, N.J., Prentice-Hall, Inc., c1966. 544 pp.

Broom, H.N. and Longenecker, J.G. Small Business Management. Cincinnati, South-Western Publishing Co., c1961. 719 pp.

Finley, Robert E. and Ziobro, Henry R. The Manufacturing Man and His Job. New York, The American Management Association, Inc., c1966. 466 pp.

Ford, Guy B. Building a Winning Employee Team. New York, American Management Association, Inc., c1964. 111 pp.

Lester, Richard A. Hiring Practices and Labor Competition. Princeton, New Jersey, Industrial Relations Section, Princeton University, c1954. 106 pp.

Mee, John F., ed. Personnel Handbook. New York, The Ronald Press Company, c1951. 1144 pp.

Raudsepp, Eugene. What the Executive Should Know About CREATING and SELLING IDEAS. Larchmont, N.Y., American Research Council, Inc., c1966. 147 pp.

WORKING

OBJECTIVES

The student upon completion of this unit will be able to understand:

1. The purpose of wages, salary and fringe benefits.
2. The importance of providing a proper physical setting for a manufacturing industry.
3. The need for providing social environment by management.

INTRODUCTION

People are the most important factor in modern manufacturing. The people hired to work in the manufacturing industry are classified in various ways, such as professional and production workers. All people working in industry, regardless of position, are known as personnel.

Professional people include those in management and the office personnel. They make the operational policies, study the profits, manage the business, and perform the clerical work.

Production people are usually classified as skilled, semi-skilled, and unskilled.

The skilled workers are craftsmen who know how to handle valuable products and materials. They build and care for the machinery and tools.

The semi-skilled workers operate machines, process and assemble materials, and act as inspectors. This is the largest occupational group in the labor force.

The un-skilled workers have little or no special training and perform such tasks as hauling, packaging, sorting, and clean-up.

Industry places the interest of all workers into three areas: economic, physical, and social. (Fig. A).

ECONOMIC REWARDS

All workers, regardless of type, work primarily to earn money in the form of wages or salaries, A wage is the pay for work done by the hour, day, or week. Salary is usually a fixed amount paid by the week, month, or year.

Skilled workers, because of training, usually receive higher hourly rates than the unskilled. Both receive many different types of incentive plans. Management personnel are usually paid by salary, plus profit sharing, stock, or a cash bonus.

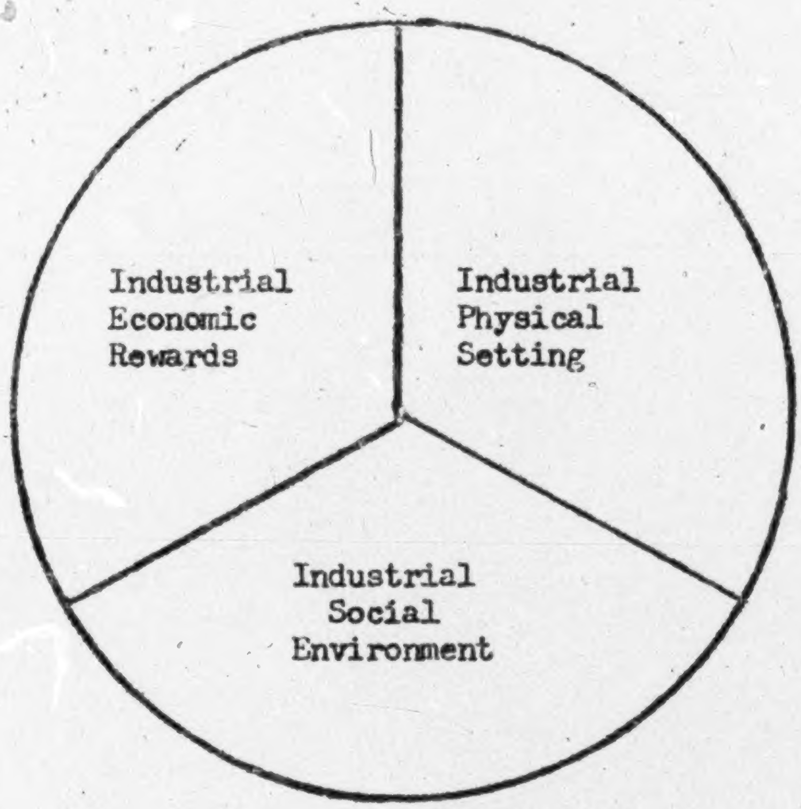

Industrial Economic Rewards
Industrial Physical Setting
Industrial Social Environment

Fig. A.
Chart of Worker's Interest Areas

The money the manufacturing industry receives from the sale of their products is divided many ways; to pay workers, buy supplies, make repairs or improvements, to pay loans and taxes. The remainder is called profit. Profit is like a wage paid to the industry. To meet the competition of our highly industrial nation, all industry must continue to earn a profit.

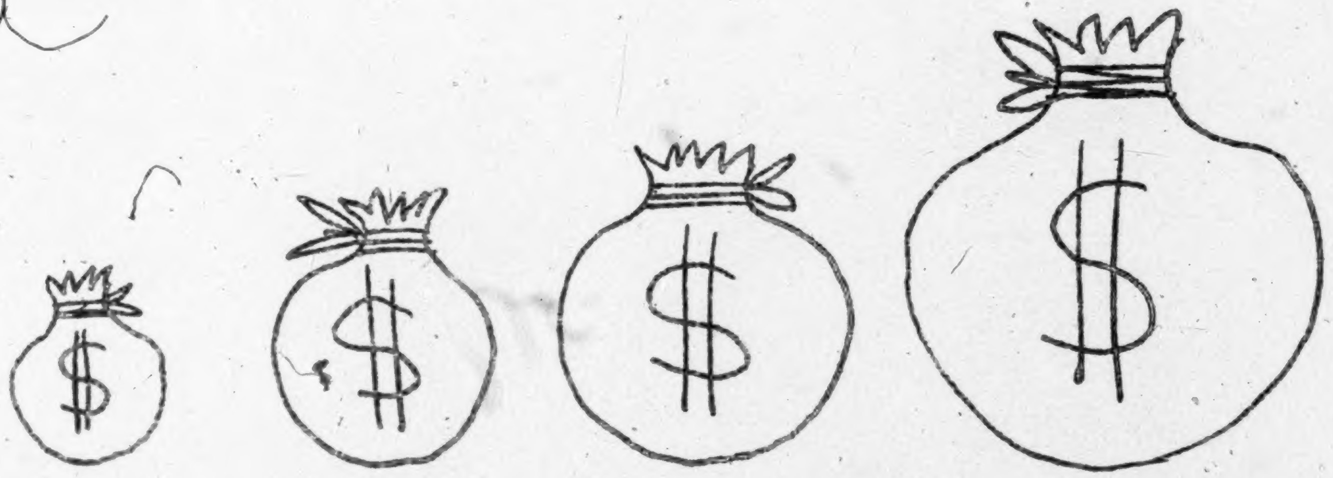
In order to attract and keep desirable workers, a company's wage

5:3

scale must be in line with the demand for labor. Wages today, in many industries, are the result of union and management successfully negotiating together. Workers receive many special benefits which are paid for by industry. These added incentives are similar to receiving extra wages.

Rest periods, ten to twenty minutes in length, are allowed twice daily. This provides the worker time to smoke or procure food and drink. This practice is prevalent where continuous operation takes place.

Six paid holidays a year are common in industry. Employees are given straight time pay for a holiday. Should it be necessary for an employee to work on a paid holiday, he may receive double or triple pay, depending on the company or union policy.



Regular Pay Overtime Pay Double Pay Triple Pay

Fig. B.

Comparison of various pay-rates.

Vacations are another of the paid time benefits. The length of the vacation varies with the length of service and nature of the position. With so many people getting vacations, some companies have found it wise to shut down during the vacation period. This shut down period, also offers an opportunity to perform maintenance on buildings and equipment.

Other than the company paid benefits, there are some extras that are paid in part by both the employee and the company. These are life insurance, hospital and accident policies, pension plans, sick leave, disability, and unemployment coverage. The various benefits, added to the wages or salaries, make the total pay received by the worker an attractive package.

PROVIDING PHYSICAL SETTING

It is evident that going to work in the morning means a lot more to a man than just a chance to earn bread and butter. It is important that his work meet his psychological needs and give him personal satisfaction.

Where wage level seems reasonable, other factors become more important than additional pay. A man must find satisfaction in his work and it must be steady. Also, a man must feel he has an opportunity to get ahead, and he likes congenial working companions. The working conditions should be good, therefore industry has to keep plant buildings and machinery clean as possible.

Neatness and cleanliness in both plant and office areas are important to safe and efficient operation. Departments working with chemicals, such as radioactive materials and similar toxic items, get special cleaning treatment.

Serving the personal needs of employees by providing clean restrooms and well ventilated locker rooms, as well as attractive eating facilities, is an important part of an effective health program.

Lighting has probably received more attention than any other factor of the plant. Management has long realized that proper lighting effects not only health and safety, but also efficiency and morale.

PROVIDING SOCIAL ENVIRONMENT

Many industries are providing for their employees, recreational activities with little or no cost to the employee. Large production units provide such things as bowling alleys and baseball fields. Smaller companies may pay for the team materials for various types of recreational activities.

Social programs are a part of the workers life, and some plants provide summer camps for employee's children. The types of social events vary according to location and size of the industry. They may consist of picnics, social clubs, parties, dances, and general get-togethers. These are usually planned in such a way that every employee will find some event enjoyable.

SUMMARY

Qualified workers are the most important factor in the manufacturing industry. Wages plus the various benefits give the American worker one of the highest living scales in the world. Management provides plant facilities that improve health, efficiency, and morale. The social environment, created for workers, depends on the size and location of the plant. Industry is trying to develop and maintain dynamic plant operation so as to attract and keep good workers.

LABORATORY ACTIVITY

Objective.

The student, after participating in this activity, will be able to fill out and calculate a time card, with or without overtime.

Materials.

1. Mimeographed time card.
2. No. 2 pencil and eraser for each pupil.

Procedure.

Mimeographed sample time cards are to be passed out to each student. (Fig. C). The student is to fill in all pertinent information such as name, department, and week-ending. Next, the student receives the time problem which is to be put on the card. This includes days and hours worked and rate of pay and in some cases overtime.

SMITH COMPANY

Weekly Time Card

Name____________________________________

Dept.____________________________________

Week-Ending_______________________________

Day-Date	Total Hours	Over Time	Hourly Rate	Earning per Day
S				
M				
T				
W				
T				
F				
S				
Total				

Signature_______________________________

Fig. C. Time Card Sample

BIBLIOGRAPHY

Amrine, Harold T., Ritchey, John A., and Hulley, Oliver S. Manufacturing Organization and Management. 2nd Ed. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1966.

Garrett, Leonard J., and Silver, Milton. Production Management Analysis. New York: Harcourt, brace & World, Inc., 1966.

Finley, Robert E., and Ziobro, Henry R. (ed.) The Manufacturing Man and His Job. The Maple Press Co., 1966.

TRAINING, ADVANCING AND RETIRING

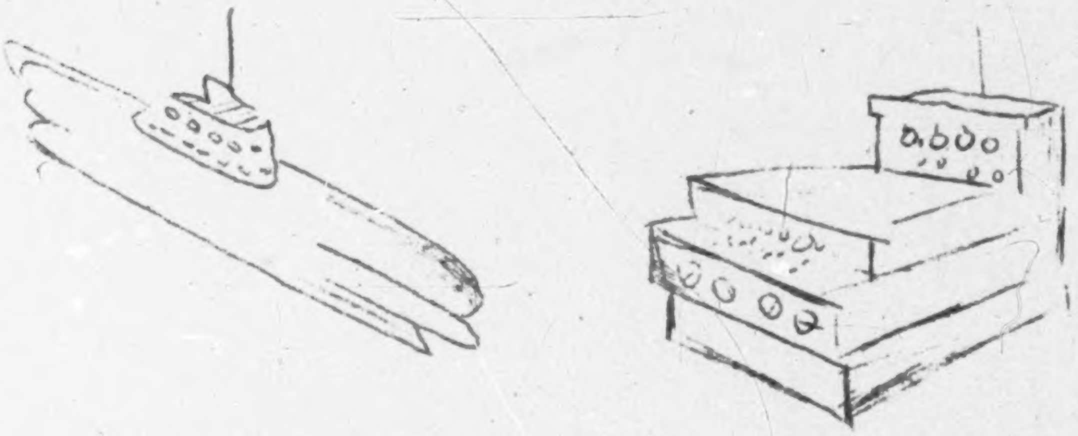
OBJECTIVES

The student, after studying this unit, should be able to understand:

1. Why factories train, promote and retire workers.
2. The meaning of apprentice, journeyman and other terms in training.
3. That a company needs well trained people to improve its business.
4. The two forces (atomic energy and new machines) that are causing a change in today's training.

INTRODUCTION

The world is always changing. Atomic energy (super power) and the computer (machine with a brain) are two wonderful new inventions. Both are changing America's way of life - not only now but in the future. (Fig. A.)



Atomic Submarine

Computer

Fig. A. New Inventions: Industrial products that are changing the American way of life.

INTRODUCTION - Continued

This new adventure of the future will make many new jobs for many people. No matter how often the change happens there will always be a need for well trained personnel. Remember, people WORK in COMPANIES which make PRODUCTS (things) which we use every day.

The man in charge of training is the PERSONNEL DIRECTOR. He aids the workers in selecting the kind of training they might wish to pursue. He also examines the worker's progress so that he might advance in his job. In addition, he advises the older worker about his leisure time activities before and after he retires from the company. The PERSONNEL DIRECTOR is meeting the challenge of tomorrow too. He knows that training is one of America's greatest needs.

TRAINING

1. APPRENTICING Four thousand years ago boys were working and learning with the master stone workers in building the great pyramids in Egypt. This young person was called a journeyman. (Fig. B.)

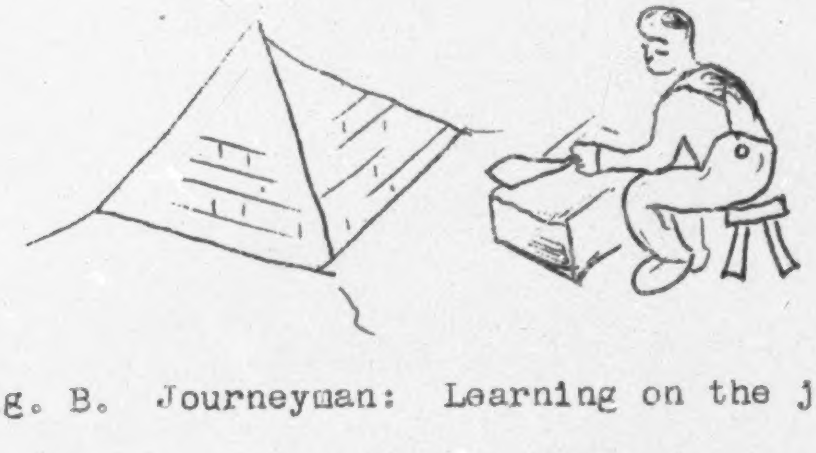


Fig. B. Journeyman: Learning on the job.

APPRENTICING - Continued

He was apprenticing - one of the first persons to use "on the job" training. Today, boys work with the master workmen to learn many kinds of trades (jobs). Here are just three: the carpenter (one who builds with wood), the printer (person who puts letters in a printing press), and the electrician (man who places the electric wires in buildings). Today, however, there are many ways a person might train for a job.

2. INTERNING The young person studying to become a doctor must spend two years in a hospital learning all he can about medicine. Here he trains with the help of other doctors to prove that he is good enough to become a working doctor. After completing the hospital training he may open up an office where people can come to him for medical aid. He has earned the title of Doctor.

3. OTHER TRAINING The worker must keep up with the latest ideas in his field of work. Special books, magazines, pamphlets, bulletins and leaflets given to him from the factory might inform him of a better way in which to do his job.

He might like to attend night school while he is working during the daytime. At this school he might learn how to run a new machine or how to become more skilled in his present work. All this extra time spent

OTHER TRAINING - Continued

to better himself will help him to progress in his job. (Fig. C.)

Fig. C. Moonlight Student: Studies at night - works in the daytime.

ADVANCING

1. PROMOTING The person who works hard at his job and spends extra time in training for new ways to do his job better is usually given a promotion (better job). This new and better job gives one a feeling of accomplishment and means higher wages. The new job can promise many things - a college education, a new or nicer home, a new car or perhaps a nice trip. These are a few of the wonderful rewards enjoyed

PROMOTING - Continued

as a result of a promotion. (Fig. D.)

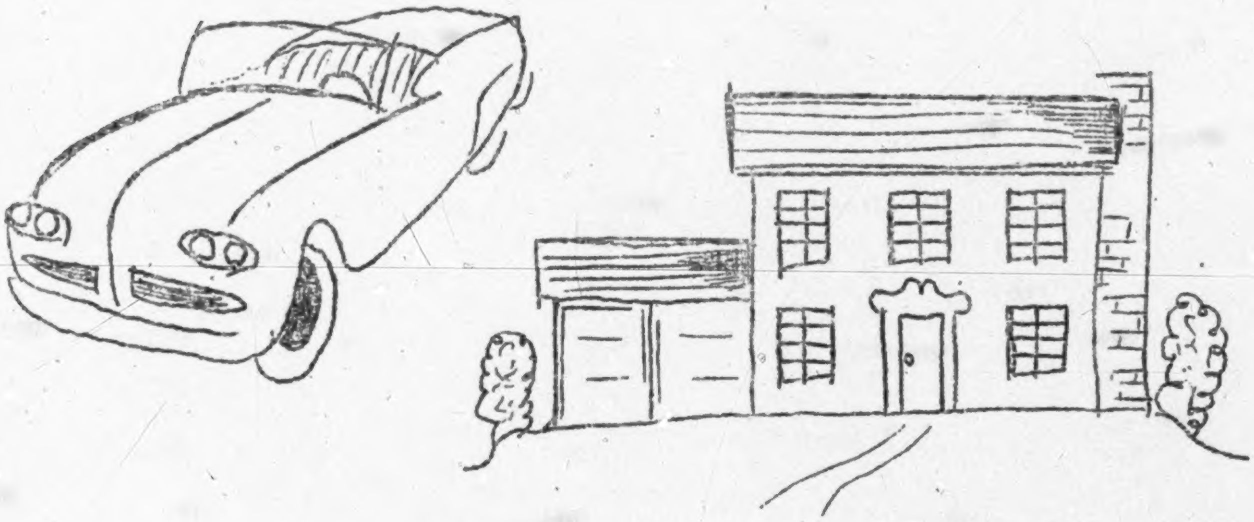


Fig. D. Results of a better job: New car - New home.

2. DEMOTING Suppose the person were demoted (moved downward) in his job? Maybe the man could not do the work asked of him or perhaps he was tardy or absent too much of the time. In some cases we find that persons do not get along with their fellow workers. These are some of the reasons why men are transferred (moved to a new job) or demoted. However, a person does not wish to do a job that is below his level of training. Usually, if you cannot do the job, you are given an easier job, and if you cannot do the easier job, you are fired (let go).

3. COUNSELING AND ADMINISTERING The personnel manager (the person who hires, gives help and fires) does not wish to see anyone dismissed from his job. He hires the

COUNSELING AND ADMINISTERING - Continued

worker and sees that he has the job best suited to his talents.

Special awards (presents) or certificates (written awards) are given for doing a wonderful task. The personnel manager might also work with the foreman (boss) to review the work the person is doing much the same as a teacher in school would do.

All of the people who run the factory (president, vice-president, superintendent and foreman) like to see that all of the workers are happy and satisfied with their jobs. A happy and contented person is a good worker.

RETIRING

When the worker reaches the age of 65 he retires (withdraws from work). At this time the person might receive a special bonus or award for his many years of faithful service. Usually the company gives the worker a monthly pension (pay without work) and in many cases, paid hospital benefits.

Retirement offers time to do all the many things which the worker has always wanted to do.

SUMMARIZING

Today the young person wishing to learn a trade trains much the same as the apprentice of years ago. He studies and works with the master craftsman until he

SUMMARIZING - Continued

knows the trade.

Interning as used by the medical profession is a good example of "on the job training."

The factory worker studying at night improves his skill so he might be advanced to a better job. He makes use of the aids offered by the Personnel Department (in the factory) telling about retirement, insurance and many other benefits offered the worker. The company knows the importance of a happy contented worker.

Finally, man must train for the new world of the future. There will be new jobs, new machines, and new ways of working. Here is the challenge of tomorrow. (Fig. E.)

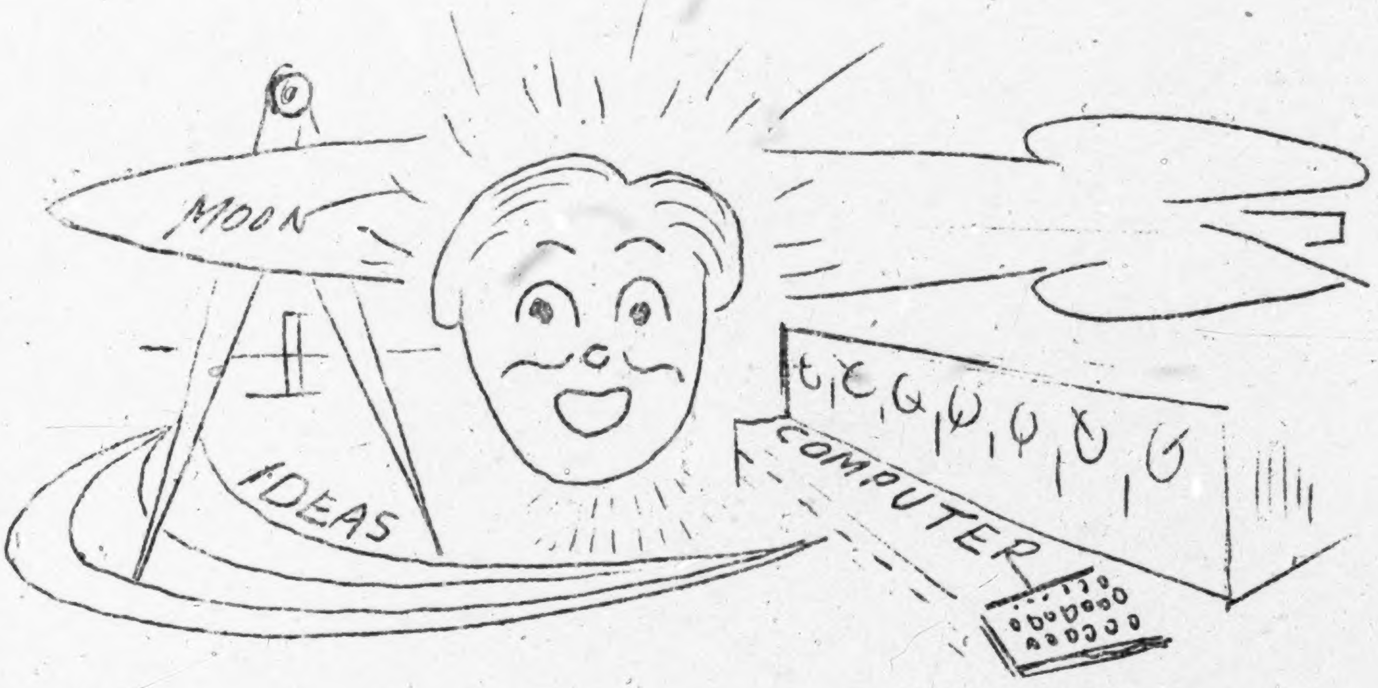


Fig. E. The Challenge of Tomorrow: New ideas, new machines and new jobs.

LABORATORY ACTIVITY

Objectives: The student, after participating in this laboratory activity, should be able to:

1. Fill out a PROGRESS CARD that shows progress in the performance (how well we work) of measuring and drawing lines and driving nails.
2. See his performance improve after a training demonstration.
3. Realize that training is easier if broken down into simple, organized steps.

Equipment:

RULER PENCIL TRY-SQUARE

CLAW HAMMER WATCH GAUGE (Fig. F.)

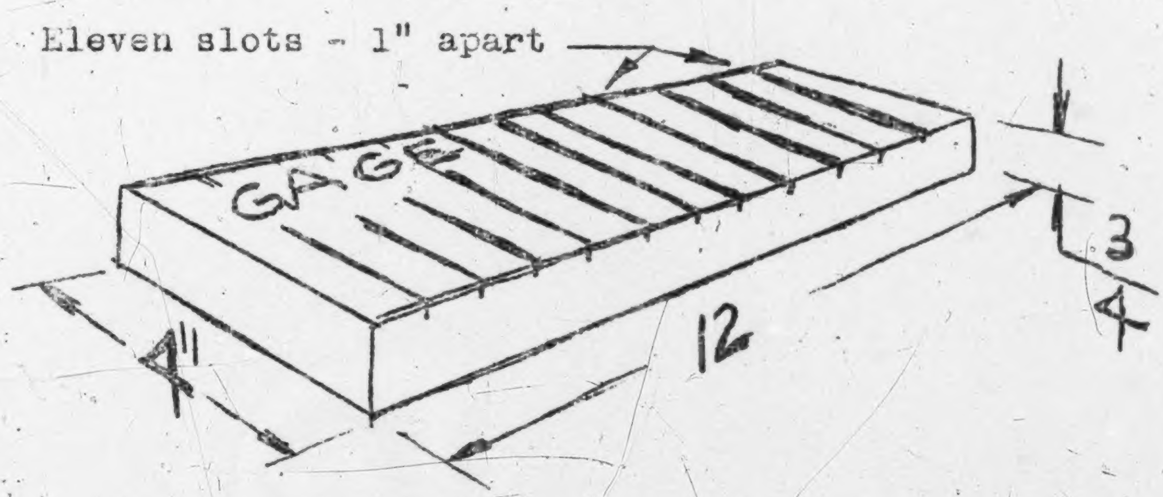


Fig. F. Gauge: To check on the job training.

Materials: (Per student)

75 Nails (approx.) three penny common

2 Pieces of soft wood, 2 x 4 x 12 inches long

Activity #1 Driving nails with no practice.

(PUPILS WILL WORK IN GROUPS OF TWO)

1. Measure the board with the ruler.
2. Place the long edge of the ruler even with the long edge of the wood. Be sure the ends of the ruler are even with the ends of the board.
3. Draw eleven dots one inch apart on the wood with the pencil. (Fig. G.)

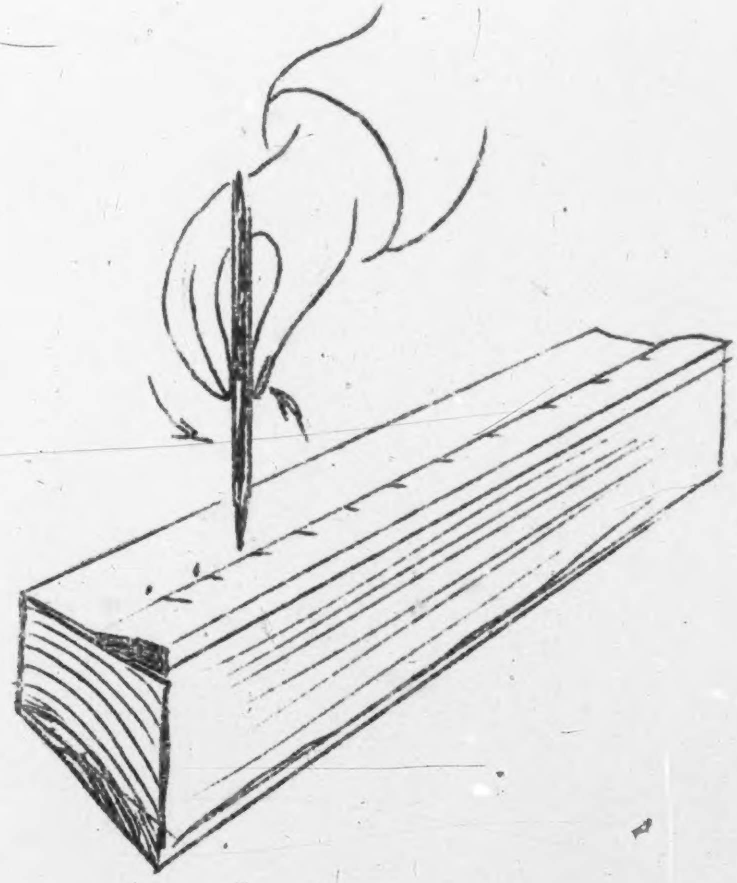


Fig. G. Measuring and marking.

Activity #1 - Continued

4. Lay the try-square on the board and draw eleven lines through the dots and across the board. Keep the handle of the try-square tight against the edge of the wood. (Fig. H.)

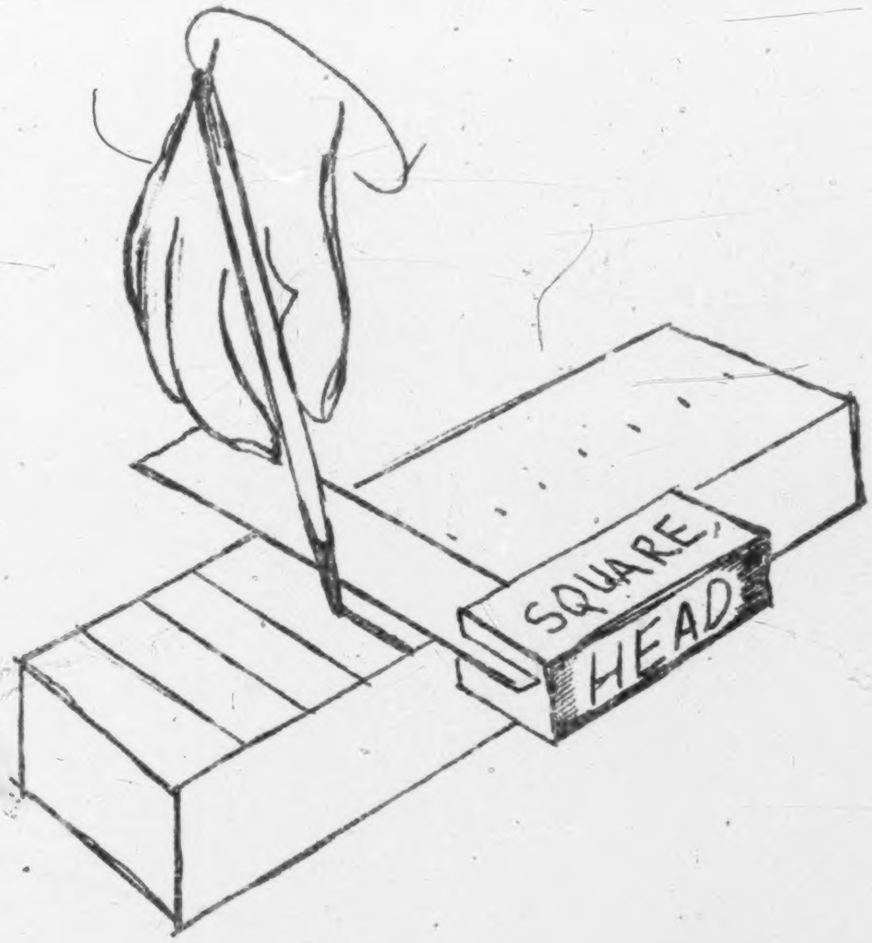


Fig. H. Drawing square lines with the try-square.

5. Driving nails. Grasp the hammer at the END of the handle. Hold the nail with the other hand. The nail must be straight. Use the square to see if the nail is straight. Strike the nail SQUARELY with the hammer. A glancing (hitting sideways) blow will bend the nail.

Activity #1 - Continued

(Fig. I.)

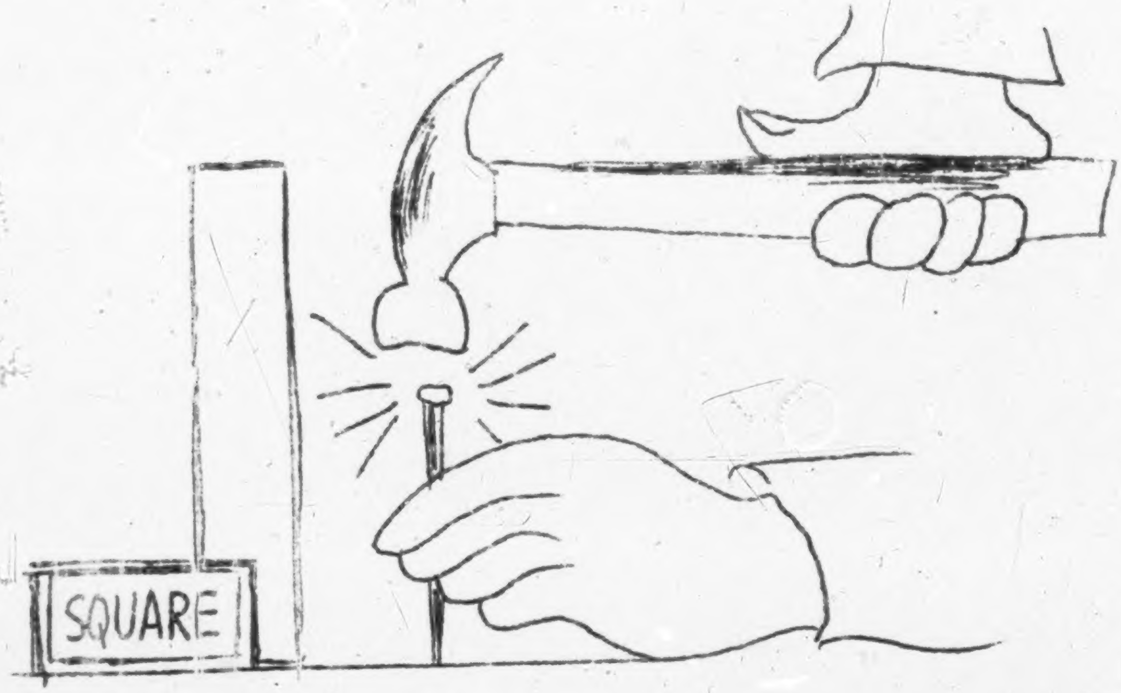


Fig. I. Driving Nails: Strike the nail squarely.

6. DO NOT DRIVE THE NAIL ALL THE WAY IN TO THE WOOD.
7. EACH NAIL GETS ONLY THREE BLOWS. Continue until all eleven nails have been driven in to the wood.
8. The GAUGE is a board with slots sawed into the wood. The reason for the gauge is to check the driven nails for alignment. (Fig. J.)

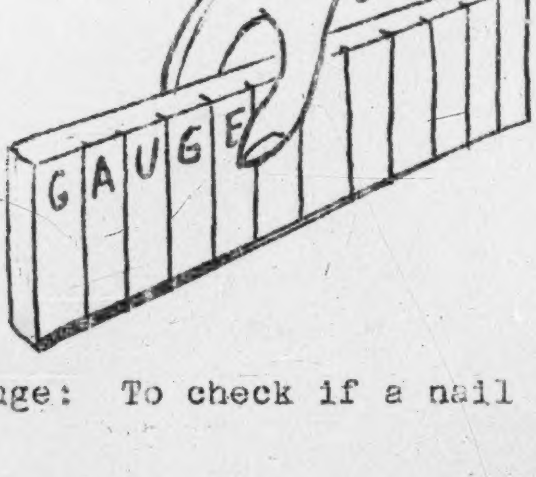


Fig. J. Gauge: To check if a nail is driven straight.

Activity #1 - Continued

9. Place the GAUGE against the board you have driven the nails into. (Fig. K.)

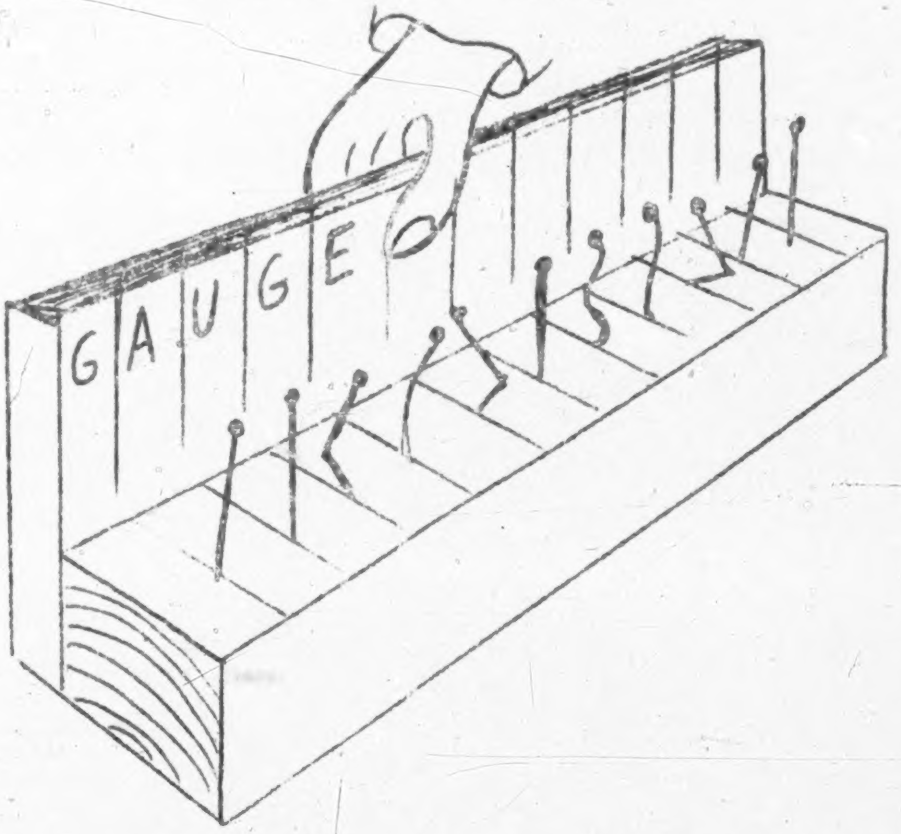


Fig. K. Gauge: Line up the gauge with the board to see if the nails are driven straight.

10. Count the number of nails that are straight. THE PRACTICE IS NOW FINISHED. If you had another chance, would you do a better job?

LET'S SEE!

TEACHER DEMONSTRATION:

The teacher will now demonstrate the correct way to drive a nail into wood. You will be told the important words such as: PENNY, SQUARE, VERTICAL, GLANCING, and other terms that you do not understand. Look at Figure I again to make sure you SEE what is important in driving a nail.

Activity #2 Driving nails after training

1. Choose a partner. Two people are needed. One person for MANAGEMENT (the person in charge) and one person for LABOR (person who does the work).
2. Become familiar with the PROGRESS CARD. (Fig. L.)

	PUPIL'S NAME			PROGRESS CARD			
	PRACTICE 1ST TRY	2ND TRY	3RD TRY	4TH TRY	5TH TRY	6TH TRY	TOTAL
MINUTES TO MEASURE AND DRAW LINES							
MINUTES TO DRIVE ELEVEN NAILS							
NUMBER OF STRAIGHT NAILS							

Fig. L. PROGRESS CARD: Write in the measuring time, driving time and the number of straight driven nails.

3. The MANAGER will record on the card:
   a. The TIME needed to MEASURE and DRAW the lines,
   b. The TIME required to DRIVE eleven nails, and
   c. The NUMBER of STRAIGHT NAILS.

Activity #2 - Continued

4. The LABORER will:
   a. MEASURE and DRAW the lines on the board, and
   b. DRIVE the nails into the wood.

   (The teacher will review this part with you.)
5. Be sure all materials and equipment are together before you start. The MANAGER must record the TIME carefully and accurately. The LABORER must do his best in doing the work.
6. After you have finished, add up the three sets of numbers across the card. This will be the TOTAL TIME SPENT and the TOTAL NAILS DRIVEN.

SUMMARY: (Fig. M.)

The information on the PROGRESS CARD will show:

PERFORMANCE - How well or how poorly you did on the job.

PROGRESS - How much you improved.

BEFORE AND AFTER - How well you did the exercise before and after being shown by the teacher.

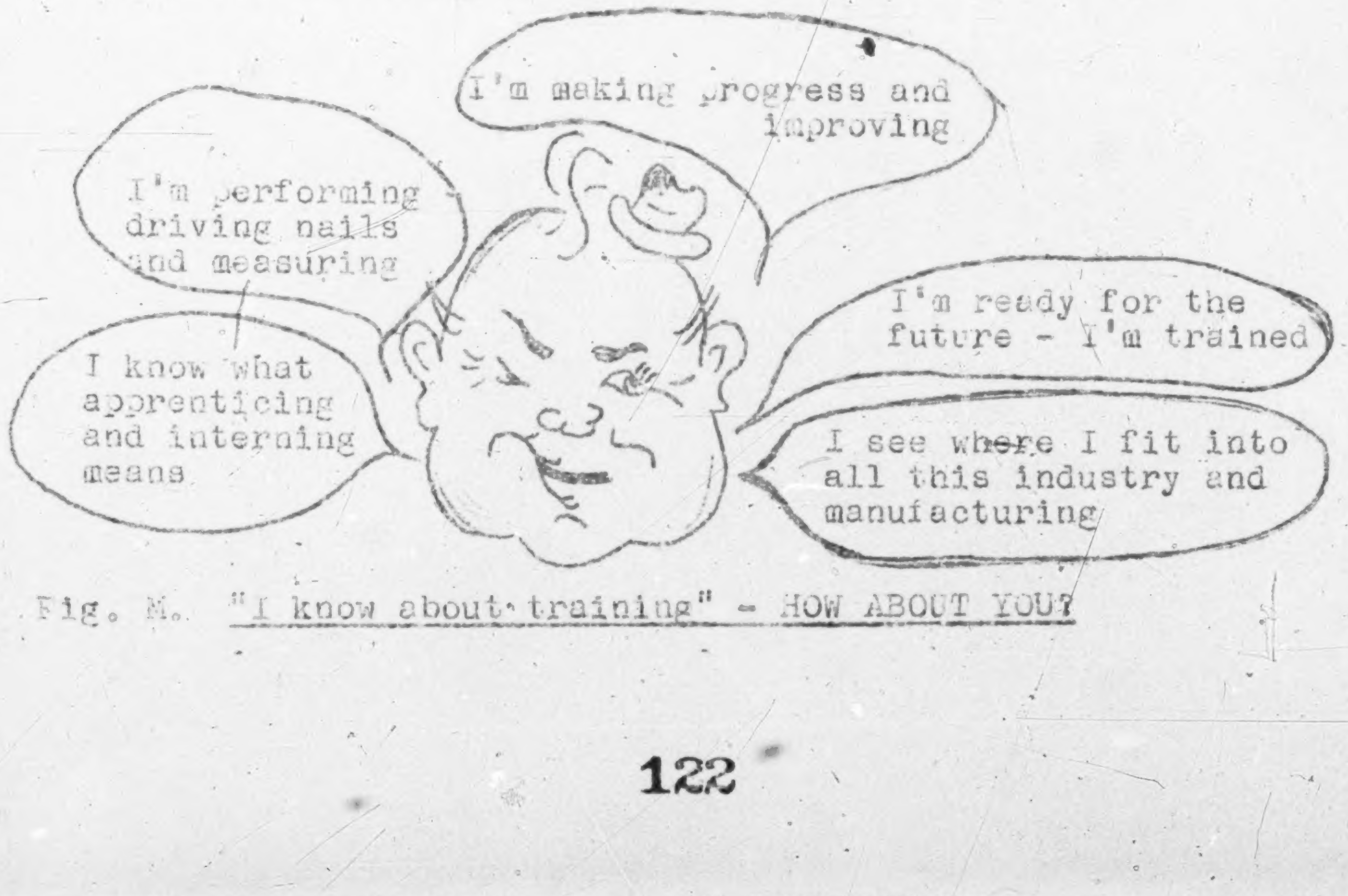

I'm making progress and improving
I'm performing driving nails and measuring
I know what apprenticing and interning means
I'm ready for the future - I'm trained
I see where I fit into all this industry and manufacturing

Fig. M. "I know about training" - HOW ABOUT YOU?

MANAGEMENT PLANNING

OBJECTIVES

As a result of studying this unit you will know the meaning of these terms:

a. Manufacture
b. Factory
c. Manufactured product
d. Manager
e. Objective
f. Need
g. Market analysis survey

and be able to answer questions about their importance in the manufacturing industry.

INTRODUCTION

Have you ever thought about who decides to make the things you see for sale in the stores? If products are manufactured that people do not want, they will not sell. Clothing, automobiles, appliances and hundreds of other products are manufactured to fulfill the needs of the people. Therefore, it is very important to decide on good products to manufacture, and how to make them so attractive that people will want to buy them.

DECISION MAKING

A baseball team has a manager. He makes decisions about which players to put in the game. He also decides on training schedules and other important matters which effect the whole team. If the manager makes right decisions the team has a good chance of winning.

At home, your parents are managers since they make important decisions which effect the family's welfare. Now that you are old enough, you are permitted to share in making some of the decisions. So you, too, are a manager in a limited way.

A factory is a manufacturing plant. Important decisions have to be made in manufacturing plants concerning products and workers. These decisions are also made by managers. If a factory is very small, the owner may have to do all the work himself. He has many management responsibilities. These include ordering materials, planning the best way to do the work, and even selling the product. (Fig. A)

Large manufacturing plants, like automobile factories, may employ thousands of workers. The decisions in this kind of factory must be shared by many managers. They called the management team or group. (Fig.B). Each member of the management group has a separate function or duty to perform. (Fig. C). The larger the manufacturing plant, the more managers there are. And it is the wise decisions of the management group,

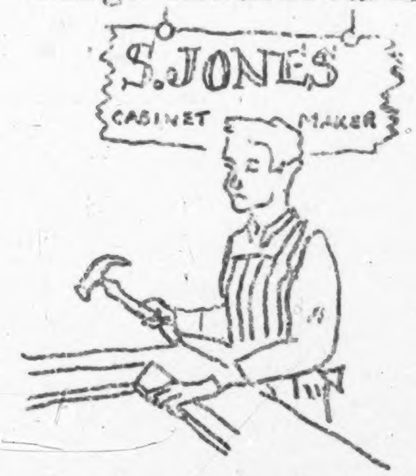


FIG. A. In a small manufacturing plant the owner is the manager.

like those of the baseball team manager, which determine the success of the business.

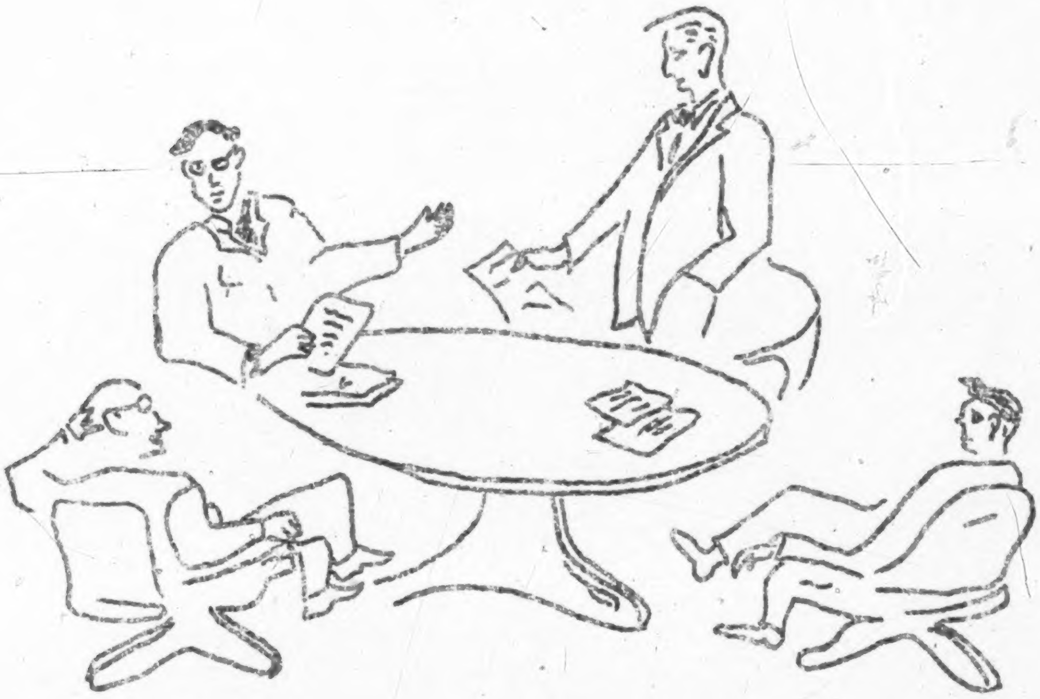


FIG. B. A management group in a large manufacturing plant.

Plant Manager ——In charge of the building itself.
Office Manager ——In charge of secretaries, bookkeepers, clerks and office machines.
Design Manager ——In charge of creating new product designs.
Personnel Manager—In charge of hiring and training workers.
Purchasing Manager—In charge of buying materials.
Production Manager—In charge of planning the steps in the manufacturing process.
Sales Manager——In charge of planning the best way to sell the product.
Research and Development Manager—In charge of experiments to find new methods and materials.

FIG. C. Management titles and their functions.

FORMULATING OBJECTIVES

Since managers have such important decision-making responsibilities, they have to be very good planners. A good starting point in planning is to decide on a product that people need. This first decision about what people need is called an objective. In the early days of America a major concern of the colonists was building sturdy homes. In those days there were no factories in our land. Most manufactured products had to be shipped across the sea from England.

One of the most needed and highly valued products for home building was nails. In 1786, Ezekiel Reed, to satisfy the people's need for more nails, invented the first nail making machine. The invention of the nail making machine permitted nails to be made by the thousands. Before, they were hand made one at a time at home.

Today we don't think much about needing nails. Instead we think of needing automobiles, T.V. sets, air conditioners, and everything else we use in our daily lives. You would have no trouble making a list of twenty or thirty manufactured products that we have come to take for granted. (Fig. D).

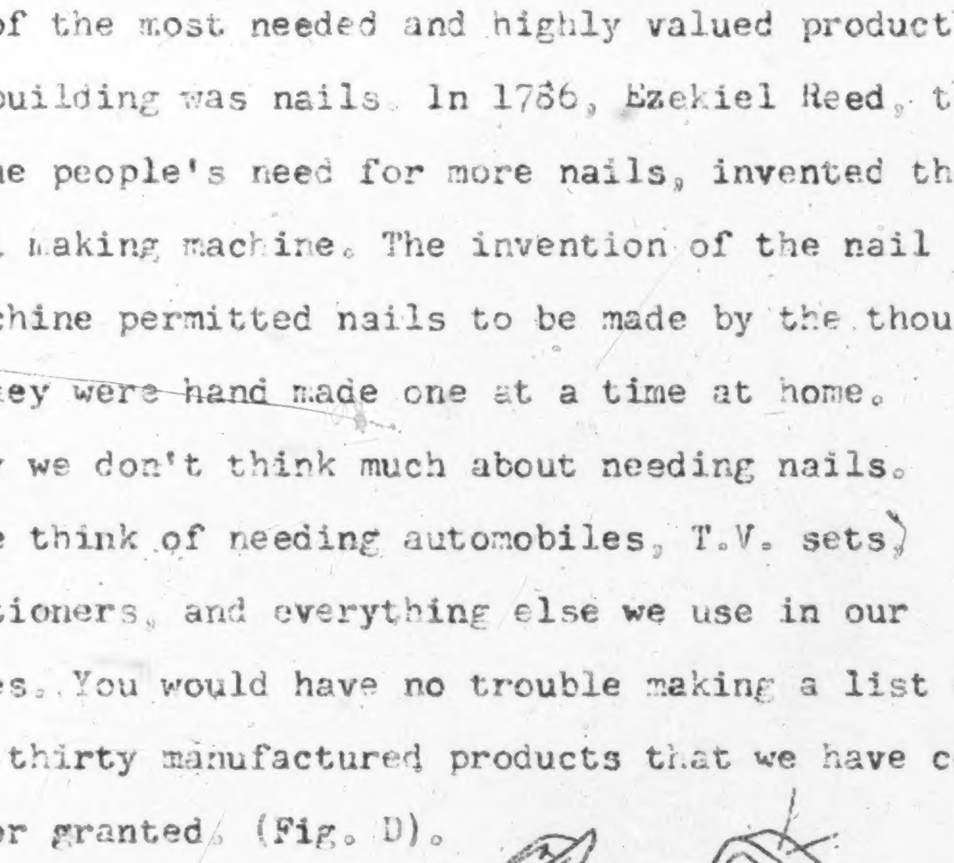


FIG. D. Products satisfy your needs.

MARKET ANALYSIS SURVEYS

Returning to the manager's decision about what to make, one way to decide is to: (1) ask store keepers what products their customers have been requesting, (2) ask people themselves what they need, and (3) study the needs of the people in a specific geographic location. Ranchers out west, for instance, would not have much need for whaling harpoons. On the other hand, business men in large cities have very little need for western saddles. This procedure for determining people's needs is called a market analysis survey.

ESTABLISHING POLICIES

In addition to formulating objectives, the manager decides on rules for activities such as: (1) production schedules (how many to make), (2) correct selling price to insure a fair profit, and (3) methods of delivery from the factory. These mamagement decisions are called policies.

FORECASTING-SETTING UP PROGRAMS

Forecasting means predicting an event before it happens. If the Weather Bureau forecasts rain, we plan wisely by taking our raincoats when we go out. Manufacturing managers try to forecast wisely by analysing the results of market analysis surveys. Then, according to their analyses, they set up programs for: (1) purchasing land on which to build the plant, (2) locating sources of supply for buying materials, and (3) setting up worker training programs. Sometimes there are not enough skilled workers living near the factory. This means that the management team might have to decide to start a training program. Accurate forecasting is most important. Many costly mistakes can be avoided through accurate forecasting.

SUMMARY

Making products is called manufacturing. Most manufacturing plants need one or more intelligent planners to make correct decisions. These decision makers are called managers and usaally they work together as a team.

Management teams decide on what products to manufacture. To eliminate guessing, managers conduct market analysis surveys. The results of surveys help managers forecast (1) plant location, (2) sources of supply, and (3) worker training programs. These decisions, based on accurate forecasting, are called objectives. Objectives are reached by setting up well planned policies and programs.

QUESTIONS ON THE READING ASSIGNMENT

1. Making things in factories is called ______________.
2. Factories are also referred to as ________________.
3. Things that are made in factories are called _________.

4. Decisions are made by____________________________.

5. Large manufacturing plants have many managers. Name four and briefly describe their duties:

   a. ________________________________.

   b. ________________________________.

   c. ________________________________.

   d. ________________________________.

6. When a manager decides what to produce (what product to make), we might say he has decided on an ________.

7. A manager decides to manufacture something because people____________________________it.

8. To help him decide on his ojectives, a manager sometimes asks people what they want. This search for information is called a________________________.

9. Predicting ahead, as a result of a market analysis is called ____________________________.

10. Rules for various aspects of manufacturing are called______________________________.

11. Production schedules, training programs, etc..., are called____________________________.

MANAGEMENT PLANNING LABORATORY ACTIVITY

OBJECTIVES

As a result of this laboratory activity you will be able to:

a. Conduct a market analysis survey.

b. Tally the results of the survey.

c. Forecast the following:

1. The products most wanted by your schoolmates, as selected from a group of fives items manufactured in the Graphic Arts Laboratory.
2. The amount of each product to make (production schedule).
3. Determine the materials needed to manufacture the product.
4. Decide on the necessity for setting up a worker training program.

INTRODUCTION

Let us think of our Graphic Arts Laboratory as a manufacturing plant. In the printing area we have machines and equipment which we can use to manufacture a product. But unless the product is needed people will not buy it. Therefore, we shall conduct a market analysis survey to find out what people want. Some of the possibilities are:

a. School stationery

b. Book labels

c. Greeting cards

d. "Thank you" cards

e. Party invitations

f. Printed T-shirts

NOTE

Samples of these products are on display in the showcase in the main lobby.

ACTIVITY

1. Preliminary survey

A. Take five Market Analysis Survey sheets (Fig. E). Using the first sheet, interview one classmate in your Industrial Arts class.

MARKET ANALYSIS SURVEY

Name Romy Smith Sec. 7-9 [✓ Boy] Girl (circle one)

1. Which of these products do you need? (circle one)
   - [✓ School stationery]
   - Book labels
   - Greeting cards
   - "Thank you" cards
   - Party invitations
   - Printed T-shirts

2. How many do you need? (circle one)	Color
10	Blue
20	[✓ Black]
[✓ 50]	Red

Figure E.

You will now have four remaining sheets to complete outside of class.

B. Divide into groups of six at your teacher's direction. Select one student in your group to act as recorder.

C. Tally the results in each group as shown in Figure F.

MARKET ANALYSIS TALLY SHEET (preliminary tally)				
PRODUCT	AMOUNT	BLUE	BLACK	RED
Stationery	/		/	
Book labels				
Greeting cards	/			/
"Thank you" cards				
Party Invitations				
T-shirts	////		/	///

Figure F.

D. At your teacher's direction interview four other students outside of class. Note: Do not interview a student if he has been interviewed by someone else.

E. When you return to class reassemble into groups and tally the remaining sheets.

F. The recorder for each group will combine the results on a Master Tally Sheet (Fig. C).

MARKET ANALYSIS TALLY SHEET (master tally)				
PRODUCT	AMOUNT	BLUE	BLACK	RED
Stationery	30	12	10	8
Book labels	26	7	4	15
Greeting cards	8	0	0	8
"Thank you" cards	4	1	2	1
Party invitations	2	0	0	2
T-shirts	50	7	27	16

Figure G.

CONCLUSION

By studying the market analysis surveys and tally sheets you will determine the product most people want. As a member of the management team you will now begin to plan with other managers to decide on the best materials and methods to use in manufacturing the product.

QUESTIONS ON THE LABORATORY ACTIVITY

1. As a result of the market analysis indicate your decision about the following items:
    a. What products will you manufacture? ____________________
    b. How many? ____________________
    c. What color ink will you need? ____________________
    d. What materials will you need? ____________________
    e. Is there a need for setting up a worker training program? ____________________

RESEARCH

OBJECTIVES

The student, upon study of this unit, should be able to:

1. Understand the roll of research in industry and why it is needed.
2. Understand how research has affected our lives socially and economically.
3. Explain the difference between basic and applied research.
4. Identify three steps of research and the need for each.

INTRODUCTION

Research is the use of certain practices to discover new knowledge. Research as we have it in modern industry got its start in the 16th Century. Such men as Francis Bacon turned men's minds from theories (unporven ideas) to that of observation, experiment, and measurement. Galilieo discovered much about astronomy. He invented instruments for navigation and a telescope to better observe the stars and planets. Michael Faraday discovered how to generate electric power in the early 1800's. Thomas Edison devoted his life to experimenting with useful ways of using electricity. Du Pont discovered many new plastic materials through chemical research. In 1916 President Woodrow Wilson organized the National Research Council, which lead the United States to become an important military power. World War I and II stimulated much research for new materials and manufacturing knowledge. Research has now become the most powerful factor in the growth of an industry. Manufacturing industries are constantly looking for better materials, processes, and products. Today there are many professional people working in research either in industry, universities, or private laboratories. It is often said, that 90% of the world's scientists are living today!

Almost everything that affects us involves research. The electric light, canned or frozen foods, the airplane, your automobile, and the floors in this room are products of research. Your doctor uses medicines to help you get well or protect you from disease. Our military defense protects us from a foreign enemy with modern and efficient weapons. Research is used to find how you learn best. Many of the things that your teachers have you doing result from research. You can see that research is looking for a better way. It is used to imporve or discover things that make our lives easier, more healthful, or more enjoyable.

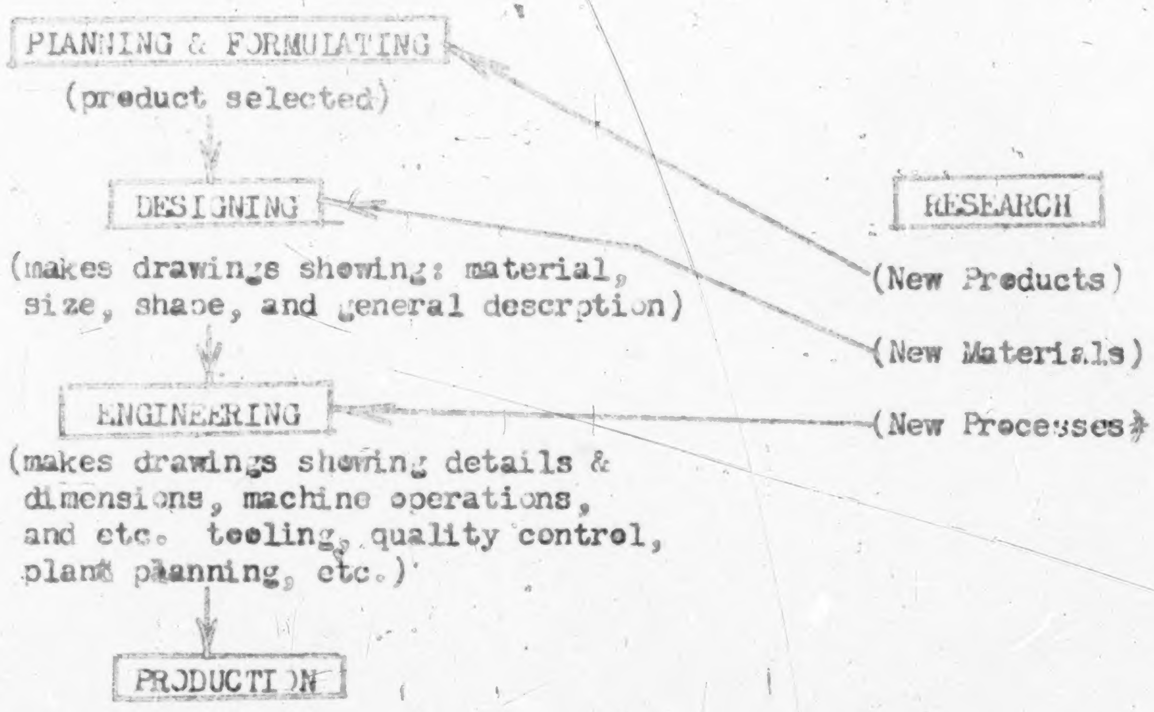

PLANNING & FORMULATING
(product selected)
DESIGNING
(makes drawings showing: material, size, shape, and general description)
ENGINEERING
(makes drawings showing details & dimensions, machine operations, and etc. tooling, quality control, plant planning, etc.)
PRODUCTION
RESEARCH
(New Products)
(New Materials)
(New Processes)

FIG. A Research: This diagram shows how new discoveries made through research may affect other areas of management.

Research -- a Part of Management - In a manufacturing industry, research is a part of management planning. It looks for information that is not known and passes it on to the other departments (Fig. A). The design department will try to make use of the new discoveries. They may change the drawings of a product. They may have the product made in a new way. The design department might even draw up a new product. The new knowledge gained by research could result in re-designing the whole plant. The design department then would inform the engineering department of these design changes. We will understand better the final results of research when we study Designing and Engineering in other units.

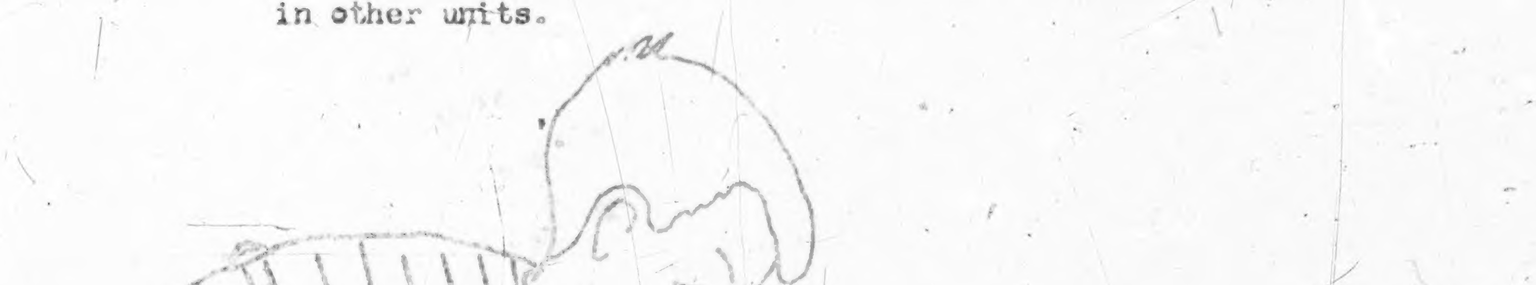


FIG. B A Problem: A coin out of reach would require some research to find a way to get it out.

RESEARCH

Have you ever dropped a coin where you could see it but could not reach it?(Fig. B). What did you do? You probably tried several different ways of getting it. When a stick did not work, you probably tried a coat hanger wire. You may have tried putting chewing gum on the stick. Maybe you asked a friend for advice. If you really wanted the coin, you were willing to keep trying different methods. After a lot of hard thinking and using different objects, you found a way to get the coin. Now that you have a way of getting the coin, you would not have this problem again. You would simply repeat your answer to this problem. Did you know that you were doing research when you were trying to get the coin? You were experimenting to find the best way to do something! Experimenting is just one of the exciting things we do in research.

Now let us look more carefully at research. Research falls into two areas: Basic research and Applied research.

Basic Research - Basic research means that we study things around us such as nature. We study to find out what something is, how it works, or why it behaves as it does. Basic research tries to satisfy our curiousity. This kind of knowledge may not have use when it is first discovered. For example; Jacques Charles, a French scientist (1787), wanted to find out what effects heat had on gases. He made many experiments. (Fig. C). He found that heat always made gases increase in volume and pressure. This discovery added new knowledge, but did not get used in practice until many years later.

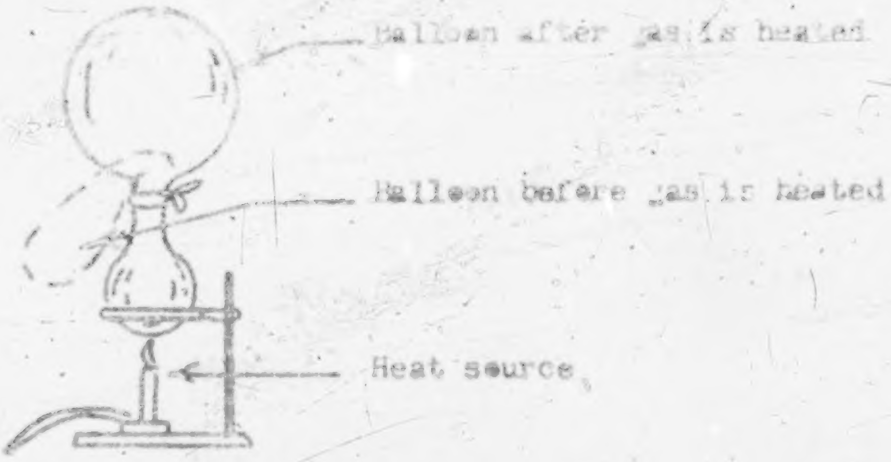


FIG. C Basic Research: Jacques Charles conducted research to discover new knowledge about the behavior of gases. This is just one example of basic research.

Applied Research - Applied research is a study to find ways that basic research knowledge might be used to solve practical problems. For example; your lawn mower may have a gasoline engine. Your mower engine gets its power from heated expanding gasses that are produced by the burning of gasoline inside the engine. (Fig. D). The discovery of heated gasses made possible the development of engines that help us do our work. Perhaps you can think of other inventions that came about because of the knowledge gained through Charles' experiments.

Applied research may be used to improve the quality of a product. It may discover new ways to produce a product which would change machines or materials. This may greatly reduce cost or labor. Through applied research, it may be discovered that a new product could be made that would replace or make obsolete other products. Most research done in industry is applied research. Great amounts of money are spent on applied research by all manufacturing companies, especially large ones. Every manufacturing industry must use research practices to stay in business.

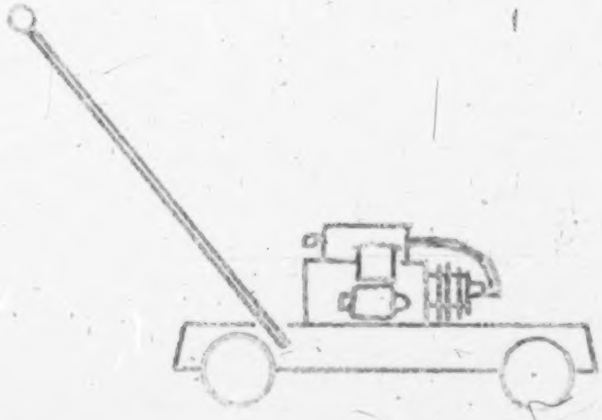


FIG. D Applied Research: The small gasoline engine on a lawn mower could not have been produced if there had not been applied research. Much knowledge has been discovered about fuels, ignition systems, oiling, and special metals that can stand high heat and wear.

If an industry does not improve their products or control prices, other manufacturing companies may get more or possibly all of the business.

RESEARCH METHODS

The research methods discussed here are mostly for applied research. Applied research is the most important kind of research that is done in industry. The three applied research methods are: (1) Describing, (2) Retrieving, and (3) Experimenting.

Describing - Describing is defining the problem. Before research can be conducted, you must know exactly what you want to find out. When you wanted to get your lost coin, you described the problem. Of course you did not write down the details, but you could have told someone exactly what the trouble was. You wanted the coin! Your problem could be clearly described as follows: (1) The coin could not be reached with your fingers,

(2) You could see the coin, and (3) The coin was close enough that you could touch it with a narrow object.

Describing the problem is required in industrial research also. Before researchers can begin experimenting and looking for answers to problems, they must know exactly what they are looking for. It would be foolish for them to start experimenting with expensive materials and equipment if they did not know what they needed to find. When the problem is defined, we are ready to retrieve information about the subject.

__Retrieving__ - Retrieving means to get information that is already known about the problem. Before a researcher spends time trying to find our something, he will first want to know if it has already been discovered. He will read books, journals, and look at studies that have been made on this subject. He may even check with other companies providing they would share research information. After retrieving and studying all the information he has, he will begin looking for solutions. He may find the answer to his problem right in the information he has retrieved. However, most research is not this easy. The knowledge that he has gained through retrieving will help the researcher to understand more about the problem. With this increased knowledge, he will try to think of possible ways to solve the problem.

__Experimenting__ - Experimenting is trying out or testing an idea to see if it will work. When you lost your coin, you tried different ways of getting it. The researcher may have many ideas for a solution to his problem. He will try the one he thinks is best. This is called a hypothesis. A hypothesis is a guess made by someone who understands the subject well. The researcher will try each hypothesis many times and many different ways. If one idea does not work, he will try another. He will try many hypothesis until he discovers one that will work. You were testing different hypothesis when you tried various objects to get the coin. The researcher may experiment using science, mathematics, chemicals, machine tools, and very accurate measuring devices. Perhaps in science and math classes your teachers have mentioned how important this kind of knowledge is to the researcher in science or in industry.

Thomas Edison had tried 10,000 different experiments that had failed. When a friend tried to cheer him, Edison said, "Why, I have not failed, I've just found 10,000 ways that won't work."(Fig. E).

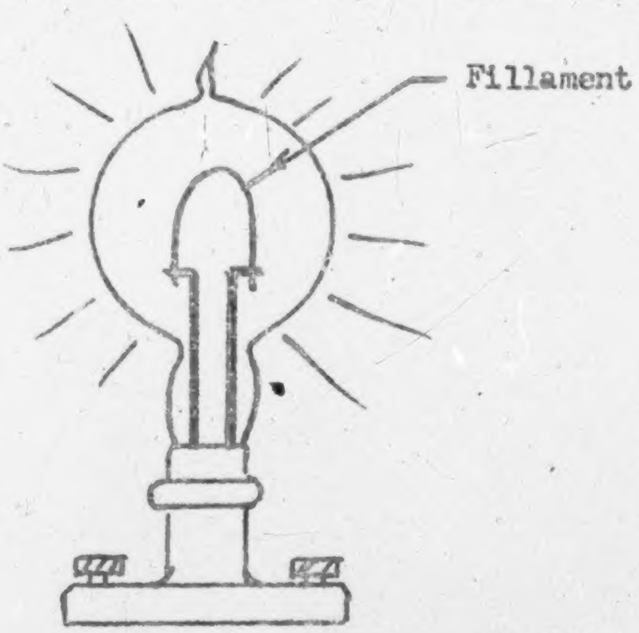


FIG. E Experimentation: Thomas Edison conducted thousands of experiments to find a fillament for his electric lamp. He tried such materials as wire, lampblack mixed with tar, and even human hair. His first successful fillament was a piece of sewing thread covered with carbon powder. Why isn't this material used today?

When you find a solution through experimenting, you should try it many times and in different ways. You want to be sure that your conclusion (a hypothesis that works) holds true in every situation. When a researcher makes a new discovery, he carefully records this new knowledge. By keeping records of what he finds, this information will always be available to him when he needs it.

SUMMARY

Research is the attempt to discover new knowledge. There are two kinds of research: (1) basic research, and (2) applied research. Basic research looks for knowledge about our universe or about nature. Basic research attempts to satisfy man's curiousity concerning the how, why, and the behavior of things. Applied research attempts to find practical use of new knowledge. Most research done in industry is applied research. Manufacturers are always looking for ways to improve or reduce costs of their products.

Applied research involves three basic steps: (1) describing, (2) retrieving, and (3) experimenting. Describing is defining the problem that you wish to research. Retrieving is getting all the information that can be found about the subject or problem. Careful study of the retrieved information will help the researcher to understand his problem better. Retrieved knowledge may even give some clues to a possible solution. Experimenting is testing the hypothesis that the researcher may have about his problem. Experimenting involves testing a hypothesis many times and many ways while measuring results. A workable hypothesis that holds true in all situations is a conclusion. A researcher carefully records all his test information and his results for futher practical use.

Research is rather recent in man's history. Since the 16th Century, many famous persons have contributed to the wealth of knowledge. They have discovered many truths because of their observations and measured experiments. Research has become the most powerful factor in the growth of manufacturing industries. They are constantly looking for better materials, processes, and products. Almost everything that affects us is a product of research. Through research, our lives are made easier, more healthful, and more enjoyable.

LABORATORY ACTIVITY

Objectives

The student, after participating in the laboratory activity, should be able to:

1. Understand the roll of research in industry and why it is needed.
2. Identify and use the three steps of research and need for each.
3. Conduct applied research dealing with an elementary research problem.

Introduction

Let us suppose that we are the research department of a large baking industry. The planning department of management has told us that we are to conduct research to find the best tasting Chocolate Chip cookie. In addition to good taste, we want to consider cost of ingredients, and cost of the manufacturing processes.

Materials

1. Flour
2. Sugar
3. Salt
4. Eggs
5. Chocolate chips
6. Milk; evaporated, homogenized, pure cream
7. Nuts
8. Misc.

Equipment Needed

1. one or more portable ovens*
2. food mixers
3. mixing bowls
4. spoons for measuring
5. small cookie sheets
6. several cook books of different publishers
7. timers
8. Misc.

*Co-operation with home economics or school cafeteria could possibly be arranged.

Student Activities

As we have read in our text, research involves Describing, Retrieving, and Experimenting. This research problem will involve each one of these activities.

Describing

List in exact detail what we want to find out in this research problem.

Retrieving

Find all the information that you can about making Chocolate Chip cookies. The following are suggestions: (1) Collect all the recipes available for Chocolate Chip cookies(CCC). (2) Ask teachers, mothers, and small bakeries about CCC. (3) Write (in advance) for information from different manufacturers and processors concerning their chocolate, flour, mixing and baking equipment, etc. (4) Buy some CCC's of other manufacturers at your local grocery.

Experimenting

After studying carefully all the knowledge available about CCC, select a combination of ingredients that you believe will make the best cookie (your hypothesis). As many combinations could be tried as time for this experimenting will permit.

You will need to devize a method of measuring the quality of your cookies and be able to make comparisons. Your experiments will be of little value if you cannot measure your results.

Recording

Accurately record every detail of your experiments. Keep account of mixing times, changes of heats, amounts of ingredients, seasonings, etc. Carefully analize all results of experiments and develop conclusions.(Fig. F).

Batch	Ingredients	Seasoning	Mix Time	Heat	Conclusions
#1					
#2					
#3					
etc.					

FIG. F Table for Recording

For Discussion

1. Is this activity basic research or applied research?
2. How is research to make a better cookie different from research to make a better lawn mower?
3. Why would a large industry want to keep their research results a secret?
4. What could happen that would make the results of an applied research problem of no value a few years later?
5. Would the conclusions drawn from this research have any effect on other products made by this baking company?

DESIGNING

OBJECTIVES

After study of this text, the student will be able to:

1. Appreciate the design process used in industry.
2. Identify the basic elements and principles of design.
3. Understand the steps in the design process.
4. Point out objects where good design principles were used.

INTRODUCTION

Have you ever wondered why a bicycle looks the way it does? Why does it have two wheels? Why does it have a handle bar for steering rather than a steering wheel? All of these questions must be answered before a bicycle can be made.

These are questions about design. Design in industry is planning to meet a need. It is a way of organizing ones thinking to solve problems about production.

Design is done by a designer. He is on the planning team of management. He is the person who answers questions about design. He would decide how many wheels to put on your bicycle. He would tell the maker to put a handle bar or a steering wheel on the bicycle. (Fig. A).

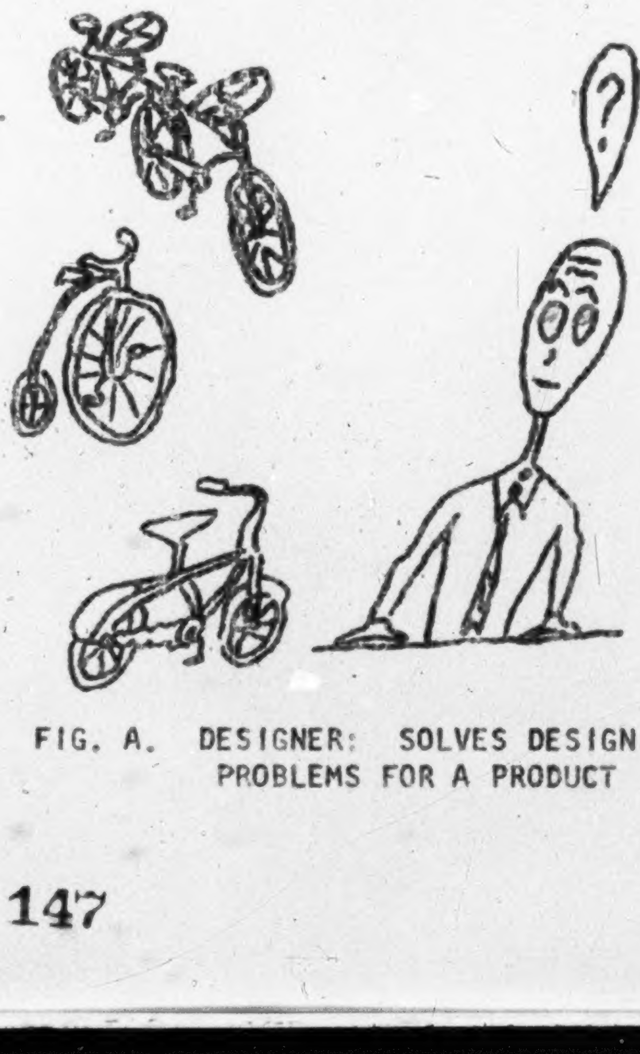


FIG. A. DESIGNER: SOLVES DESIGN PROBLEMS FOR A PRODUCT

Designing products takes place after much research has been done. This research is necessary to find the answers to things that need to be known. For example, what kind of paint would wear best on a new bicycle? The bicycle maker would have to test and experiment to find the best wearing paint.

Design problems are solved very much like research problems are answered. It is a step-by-step procedure. Designing, when carefully done, includes: (1) Determining functional requirements, (2) Design elements and principles, (3) Design Communications, (4) Choosing possible design solutions, (5) Testing and experimenting for solutions, and (6) Choosing the best design solution.

DETERMINING FUNCTIONAL REQUIREMENTS

Industry is very careful about the products they make. They do not build a product that first comes to mind. This would be foolish. Instead, a careful study is made in advance. The study determines if people will buy a product or not. This is called market research.

This is a very important task for industry. For industry to stay in business, they must sell what they produce. Sales means profit! Profit means industry! Industry means jobs!

Function--For a product to sell, it must have a use. To put it in design terms, it must have a function. If a product has no function, it is useless. An example of a product with a function is a bicycle. A bicycle is sold because it meets the transportation needs of children. If children liked to walk everywhere, rather than ride, there would be little need for bicycles.

Specifications are the details of a product. In order to build a bicycle, a designer must answer some questions about the bicycle. The answer to these questions explains the details of the product. These details are called product specifications. Specifications concerning a bicycle might be: (1) Two, 26 inch diameter wheels, (2) Chrome plated handle bar, (3) Four speed gear shift, and (4) Steel tubing frame. These specifications tell the story of the product. They tell the maker exactly what kind of bicycle to build. They would build the bicycle to fit the design specifications.

DESIGN ELEMENTS AND PRINCIPLES

The designer knows that a product should look good to sell. The product should be pleasing to the eye. If a girl has a pleasing appearance, you say she has good looks. Therefore, if an industrial product is to sell in large numbers, it should have good looks.

When a designer designs industrial products, he does this by using certain elements of design.

Design elements could be thought of as the building blocks of design. It takes many of these blocks to make a building. Four main elements of design are: (1) Lines, (2) Planes, (3) Solid Forms, (4) Surface treatment.

1. Lines show the shape of an object. A designer uses many different lines to show the shape of his product. (Fig. B).

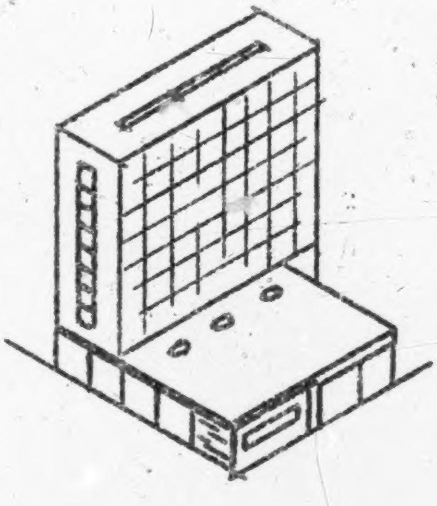


FIG. B. LINES SHOW THE SHAPE OF AN OBJECT

2. Planes. Curved and straight lines can be put together to form a flat surface. The flat surface on a desk top would be a plane. Flat surfaces are called planes. (Fig. C).

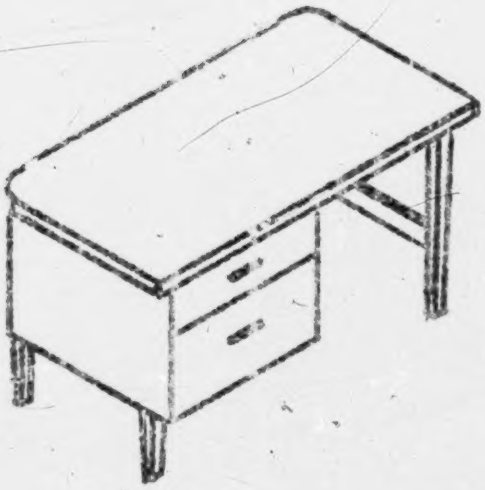


FIG. C. PLANE: THE CURVED AND STRAIGHT LINES OF A DESK TOP FORMS A PLANE

3. Solid Forms. Planes can be put together to make solid forms. For example, several planes are put together to make a toy block. A combination of several planes make a solid form. (Fig. D).

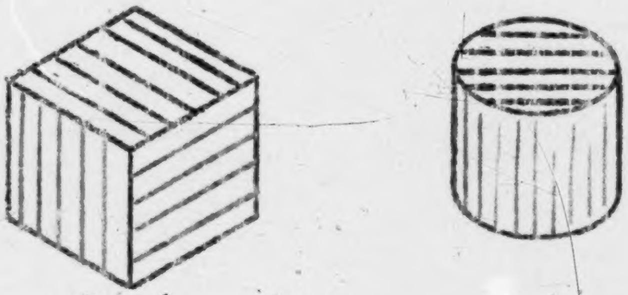


FIG. D. PLANES PUT TOGETHER MAKE SOLID FORMS

4. Surface Treatment. Surfaces of objects may be changed to suit our needs. The surfaces of materials may be changed by coloring, polishing or making them rough. The surface

treatment on most bathroom tile is very smooth, but it can be made rough. It can be further changed by adding color. The changes we give surfaces are called surface treatments.

Design principles. Every industrial product contains design elements. Design elements can be arranged to give a pleasing appearance if certain rules are followed. These rules are called design principles. These principles are like the rules of a game or the rules of your gang. They tell the way to do things. The four main principles of design are: (1) Proportion, (2) Balance, (3) Emphasis, (4) Unity.

1. Proportion tells the relationship of the size and shape. If a table top is two feet wide and three feet long, its proportion would be 2 to 3. This is an example of good proportion. (Fig. E).

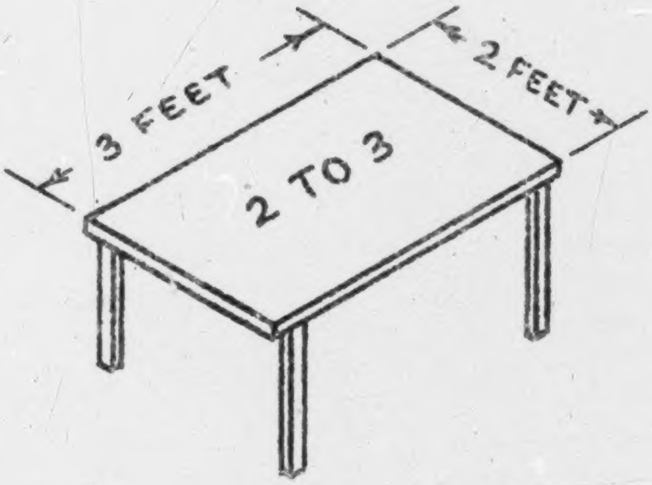


FIG. E. PROPORTION TELLS THE RELATIONSHIP OF THE SIZE AND SHAPE

2. Balance. A balance scale is used to weigh out equal amounts. When things are equal on both sides, they are balanced. In design, if things on both sides are equal, they are balanced. (Fig. F).

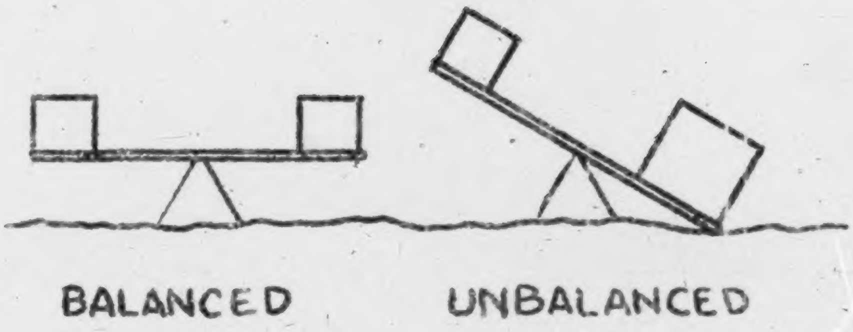


FIG. F. EXAMPLES OF BALANCE

3. Emphasis means eye-catching. It is something that draws your attention. If you see a good looking girl in a crowd, this would be eye-catching. This is an example of emphasis. In design, things are added to products as points of emphasis. This is done to make the product more attractive.

4. Unity means that things go well together. When you put on your "Sunday best" for church, you would not wear tennis shoes as footwear. This would be an example of poor unity. Things should go together in design to show unity.

DESIGN COMMUNICATIONS

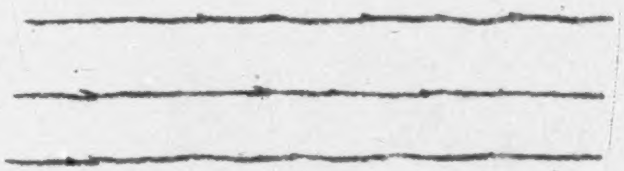
When a designer designs a product, it is necessary to show the production department how to build it. A designer cannot personally instruct each production section. Instead, he puts his ideas on paper.

He uses freehand sketching and pictorial drawing to tell others of his ideas.

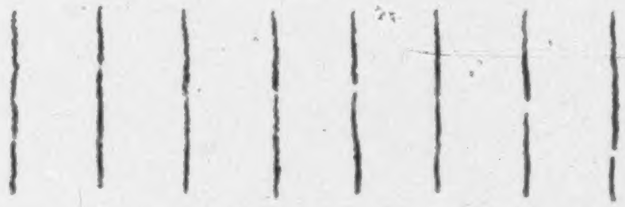
Freehand sketching. Sketching is putting ideas on paper by means of freehand drawings. Sketching is one of the best ways to organize thoughts on paper. As ones thinking becomes clearer, sketches become more complete.

There are several different lines and shapes one should know before he can sketch properly. These are:

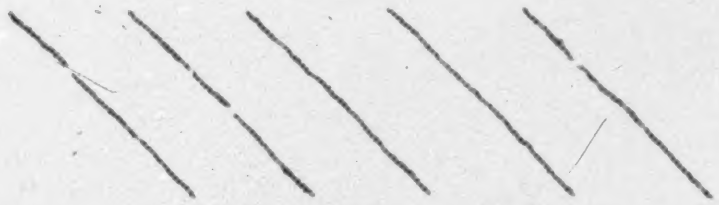
Sketched horizontal lines



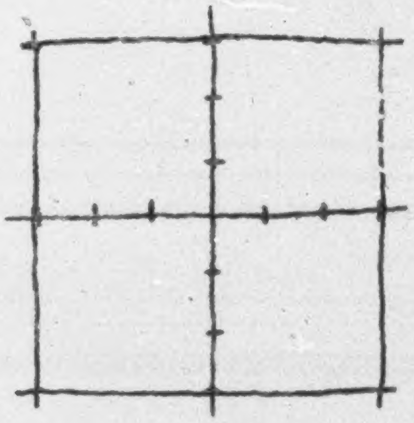
Sketched vertical lines



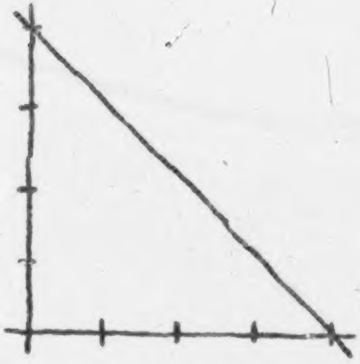
Sketched sloping lines



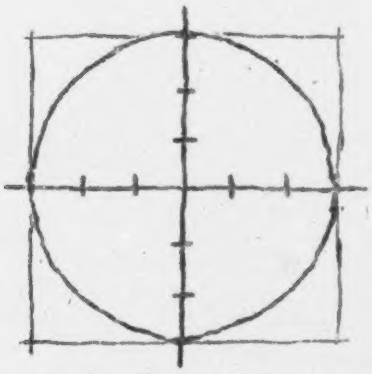
Sketched square



Sketched triangle



Sketched circle



By the use of the above lines and shapes, one should be able to make a satisfactory freehand sketch.

Pictorial drawing. When you did your freehand sketching practice, you learned how to draw lines and shapes. Let us now learn to sketch a three dimensional object. (An object that has length width and depth.) This general type of drawing is called pictorial drawing. They are drawings that look like pictures. (Fig. G).

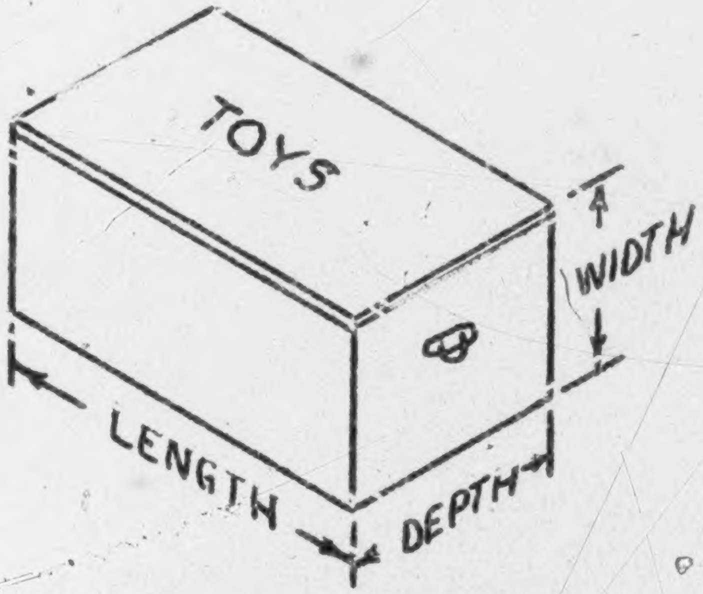


FIG. G. A PICTURE TYPE DRAWING

An isometric drawing is a type of pictorial drawing where one corner of the object is nearest to the viewer. It is best suited for square and rectangular objects. (Fig. H).

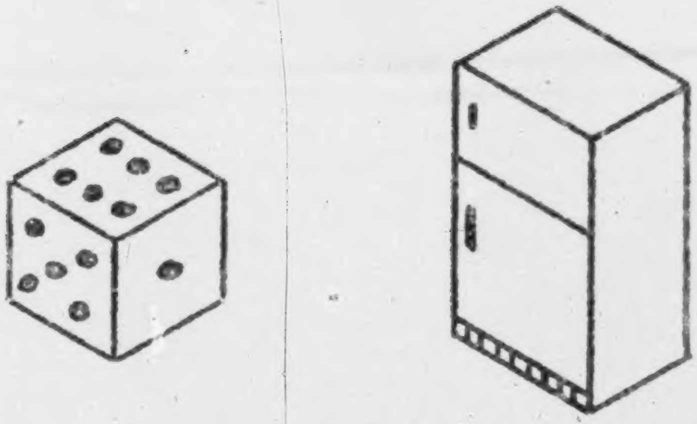


FIG. H. ISOMETRIC DRAWING BEST SUITED FOR SQUARE AND RECTANGULAR SHAPED OBJECTS

Isometric means "equal angle". The "Y" forms the starting point for all isometric drawing (Fig. I). You can see why they are considered to be pictorial (picture drawings).

An isometric drawing is made around three lines that are exactly 120 degrees apart. One line is drawn vertical (up and down ↕), and the other two are drawn at a 30 degree slope (↘ ↗) to the horizontal (sideway ↔) line. (Fig. J).

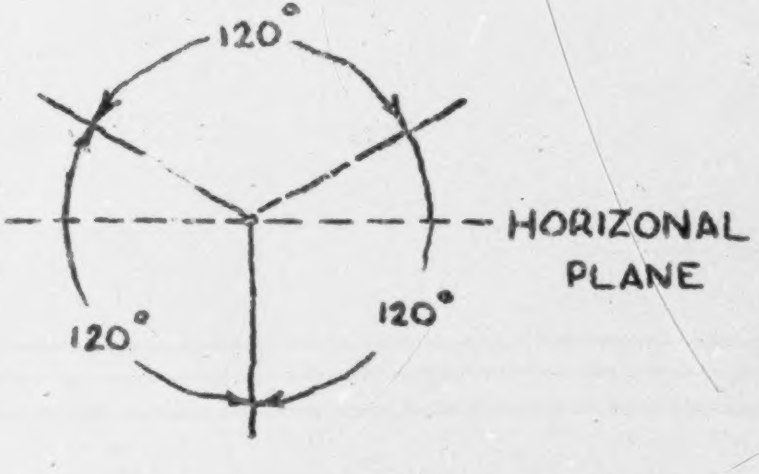


FIG. I
ISOMETRIC MEANS "EQUAL ANGLE"

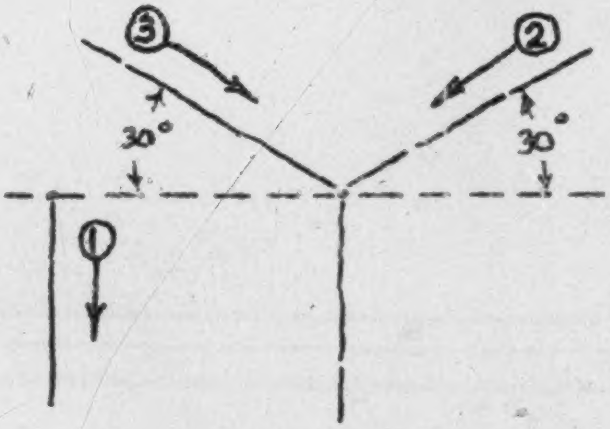


FIG. J
STEPS IN ISOMETRIC DRAWING

CHOOSING POSSIBLE DESIGN SOLUTIONS

You have learned how a designer, by freehand sketching, tells other people of his ideas. This is a language in itself. It is very difficult to explain a mechanical part to some people by the use of words. It has been said that "A picture is worth a thousand words".

You can see that you now have the ability to show an object to someone by use of a sketch. This gives you the ability to explain things faster and more exactly. It gives you another language to use. The language of drawing.

When a designer knows the function and specifications of a product, he takes the next step. He tries to figure how the product will look when finished. He does this by the use of many freehand sketches. He knows that ideas are quickly thought of and then forgotten. Therefore, he puts his ideas (sketches) on paper before he forgets them. In doing this, he is collecting answers to his design problem. Then the final step would be to choose the best design from his many sketches.

TESTING AND EXPERIMENTING FOR SOLUTIONS

The problem the designer faces at this point is to choose his best design. He finds his answer by testing and experimenting with his several design ideas. The designer checks to see which of his ideas best meets the design specification.

CHOOSING THE BEST DESIGN SOLUTION

After careful testing of his design ideas, the designer chooses his best design. This design best meets the design specifications. It is the best looking and most functionally designed product.

SUMMARY

Management in industry is concerned with the design of products. Product design is done by the designer. Designing is planning to meet a need The designer is the person on the management team who solves design problems.

The designer solves design problems by a step-by-step procedure. The steps are: (1) Determining functional requirements, (2) Design elements and principles, (3) Design communications, (4) Choosing possible design solutions, (5) Testing and experimenting for solutions, (6) Choosing the best solution.

Determining functional requirements involves discovering the exact function and specifications of the product.

Design elements and principles are used by the designer to insure a good looking product. The elements of design are lines, planes, solid form, and surface treatment. The principles of design are proportion, balance, emphasis and unity.

Design communications is needed to enable the designer to tell others of his design ideas. Design ideas are told by sketching pictorial drawings.

Choosing possible design solutions is the step where many possible design answers are collected.

Testing and experimenting for solutions is the step where these many design solutions are tested. They are tested to find the best solution.

Choosing the best design solution is the final step in the design process. In this step the best design solution is found which meets the specifications.

LABORATORY ACTIVITY

Activity No. 1 - Freehand Sketching

Objectives

To enable the student to do simple freehand sketching will include: (1) Horizontal lines, (2) Vertical lines, (3) Sloping lines, (4) Squares, (5) Triangles, and (6) Circles.

Materials

1. Soft lead pencil, No. 2
2. Unlined ditto or mimeograph paper

Procedure

A designer must be able to tell other people of his ideas. He often does this by the use of a freehand sketch. The designer uses several general rules for sketching.

1. Hold the pencil rather loosely in your hand about one inch from the point.
2. Pull the pencil twoard you as you sketch.
3. Never push the pencil.
4. Use arm movement rather than wrist and finger.
5. Draw a light, wavy line and put breaks in the line.

Designers use several lines and shapes in freehand sketching. They are:

1. Horizontal lines

Place points on your paper for the beginning and end of the line. Draw from left to right. Try to look at the whole line to keep it straight.

When you get to the end of the line, go back over it to darken it.

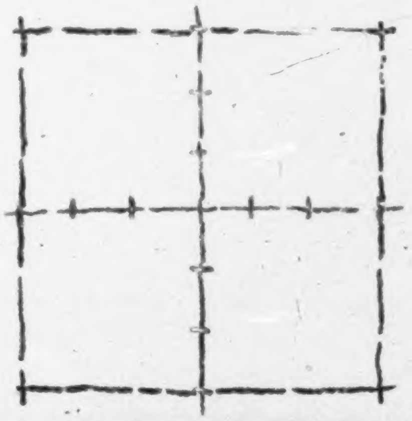
2. Vertical lines

Draw from the top down, pulling the pencil toward you. Get used to making all lines on the paper in the same position.

3. Sloping lines

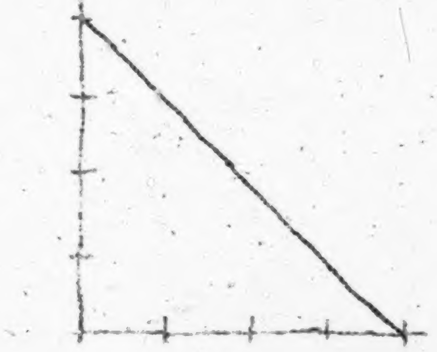
Draw these lines from the top down, either from the upper right to the lower left or from the upper left to the lower right.

4. Squares



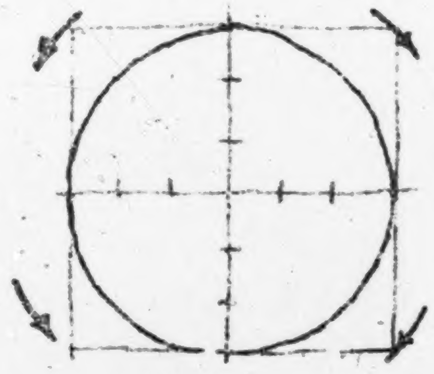
Sketch light vertical and horizontal lines that intersect. Mark off divisions for the width and height of the square. Make the divisions the same size. This is done to make sure the square is accurate. Now lightly sketch the square by drawing lines to intersect at the corners. Then darken the square with a heavier line.

5. Triangles.



Sketch light vertical and horizontal lines that intersect at a corner. Then lay off the height divisions of the triangle on the vertical line. Now lay off the base divisions on the horizontal line. Darken the three sides with a heavy line.

6. Circle



Sketch light vertical and horizontal lines that intersect. Mark off divisions for the width and height of the square. Make the divisions the same size. Now lightly sketch a square by drawing vertical and horizontal lines to intersect at the corners. Start your circle by working outward from each center line. The circle will be drawn in four parts. Complete the circle and darken.

Activity No. 2 - Isometric Sketching

Objective

To enable the student to do simple freehand isometric sketching.

Materials

1. Soft lead pencil, No. 2
2. Unlined ditto or mimeograph paper
3. Ruler or scale

Procedure

Sketch the isometric object by following the suggested procedure. (Fig. A).

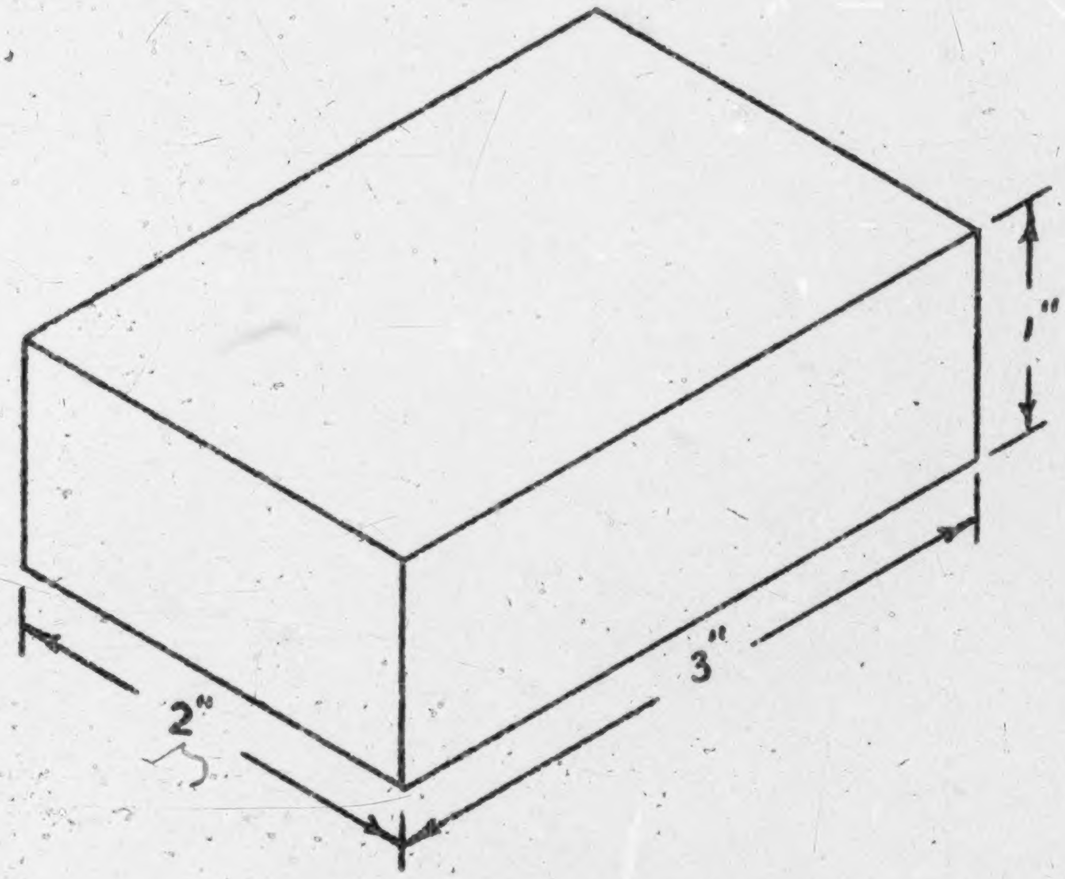


FIG. A

1. Draw a light dashed (- - -) line on your paper. Then layout the vertical line. Next, layout the two sloping lines at a 30 degree angle to the horizontal line. (Fig. B).

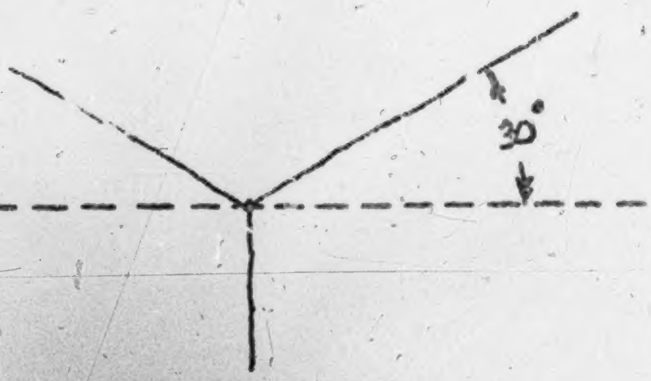


FIG. B

2. Your finished drawing should look like Figure A. To make it as exact as possible, measure the length, width and depth and transfer it to your sketch. You may do this with a ruler or guess by eye. (Fig. C).

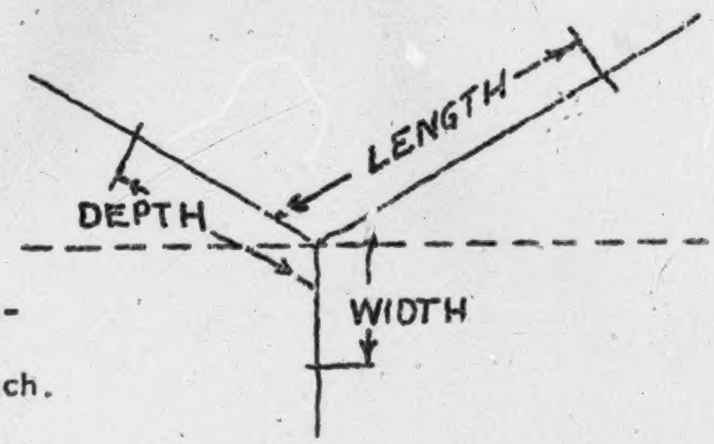


FIG. C

3. Draw in lightly all parallel lines. (Lines that are the same distance apart). Be sure to keep the lines parallel. (Fig. D).

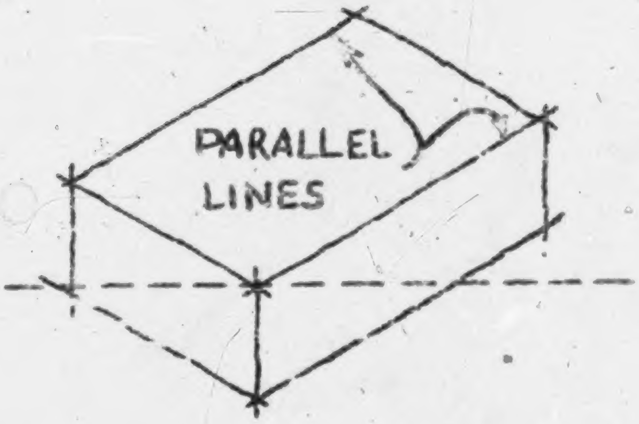


FIG. D

4. Erase all extra construction lines and darken the object. (Fig. E).

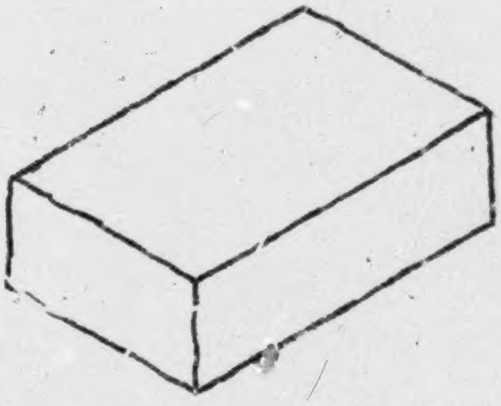


FIG. E

5. Add dimension lines as shown in Fig. A. Dimension lines are necessary to show the size of the object. (Fig. F).

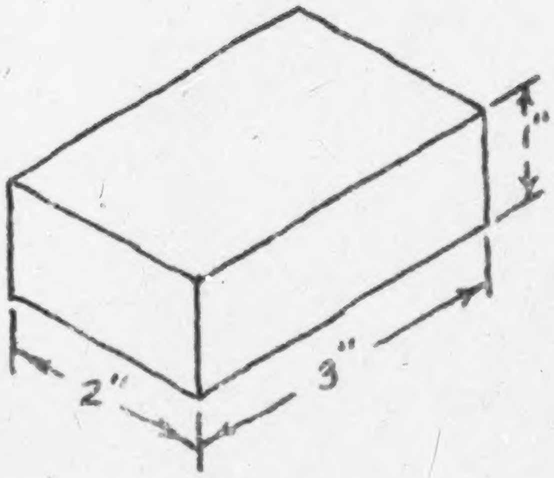


FIG. F

Activity No. 3 - Designing an Industrial Product

Objective

To enable the student to design a simple industrial product.

Materials

1. Soft lead pencil, No. 2
2. Unlined ditto or mimeograph paper
3. Ruler or scale

Procedure

The class will be divided into groups of four each. These groups will be called design groups. The class will be given a design problem. Each design group will take this design problem and sketch their best design solution.

1. Design Problem: Design a wooden holder for books to use on a desk top.

2. Product Specifications:

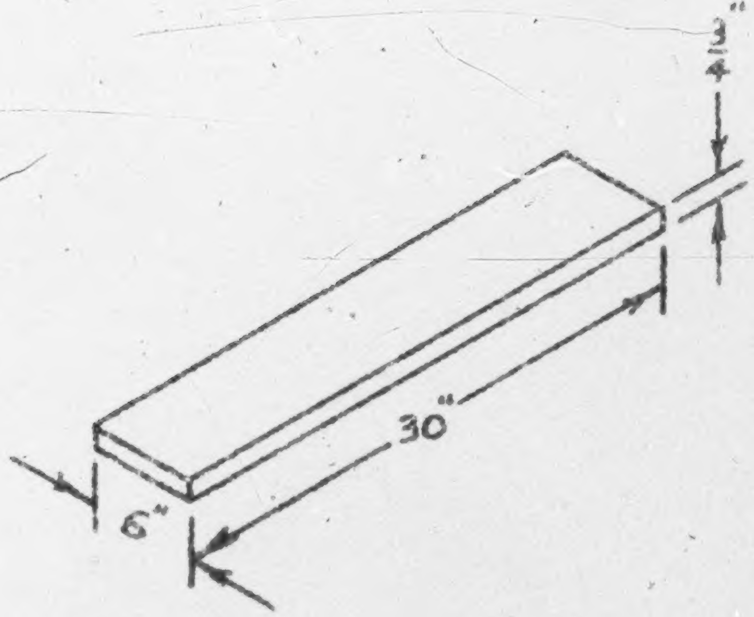
(1) Must be large enough to hold 15 average size books. The largest book being 8" x 11". The smallest book being 6" x 9".

(2) Must be made so that books may be easily removed.

(3) Must be simple in construction.

(4) Must not scratch desk top.

(5) Must be made of the piece of wood shown below. You may use less wood, but no more.



ENGINEERING

OBJECTIVES

The student, after studying this unit, will be able to better understand:

1. What an Industrial Engineer does and how to prepare to be one.

2. How an Industrial Engineer helps with planning by detailing specifications.

3. That an Industrial Engineer knows how to write work standards and methods.

4. That estimating and scheduling are also important parts of the manufacturing process.

INTRODUCTION

What is an engineer? If you were an engineer, how would your work be different from that of other people? Engineers build bridges (Civil Engineers), design televisions (Electrical Engineers), and make the exciting rides you enjoy at the park (Mechanical Engineers). They work on the very tiny parts of a television set and on the huge dams that hold mighty rivers. Their jobs may be in the town where you live or anywhere in the world.

There is a word in our language called ingenuity. It means being able to find a way to do things. Engineering and ingenuity are alike because the important thing about an engineer is that he must find out the best way to do things. Therefore, engineers use a problem solving approach in seeking answers to industries problems.

Perhaps you would like to know your possibilities of being an engineer. Students who plan to be engineers should study a lot of Mathematics, Science, English and Industrial Arts. Mathematics is the "language" of engineering. Science is necessary for the understanding of materials. English is important because an engineer must prepare reports which are quite technical. Industrial Arts will help you to understand how materials and equipment are used.

We want to learn about a certain kind of engineer. We will call him an Industrial Engineer. He is part of industries planning team. His job will be to take a product which has been designed and get ready to manufacture it. He must know how to detail design information which has been given to him. He must understand work methods, standards and processes. He will also be good at estimating and scheduling. Each of these activities will be defined as we proceed.

INDUSTRIAL ENGINEERING

Detailing specifications means to sort out the information about how to make a certain product and pass it on to the people who should know about it. (Fig. A.) For example, the Industrial Engineer will write the tooling and equipment specifications from the product specifications. Specifications are just a good description of something. He must also write the manufacturing specifications, methods, and work standards. This is necessary so that the finished product will meet the specified manufacturing standards. He will be concerned as to how the factory is built so the product will be manufactured as efficiently as possible. To make something efficiently would be to do it without loss of time or energy. If a product is not made efficiently, the company would probably not make a profit because of waste. A company that does not make a profit would soon go out of business and a lot of people would have to find new jobs.

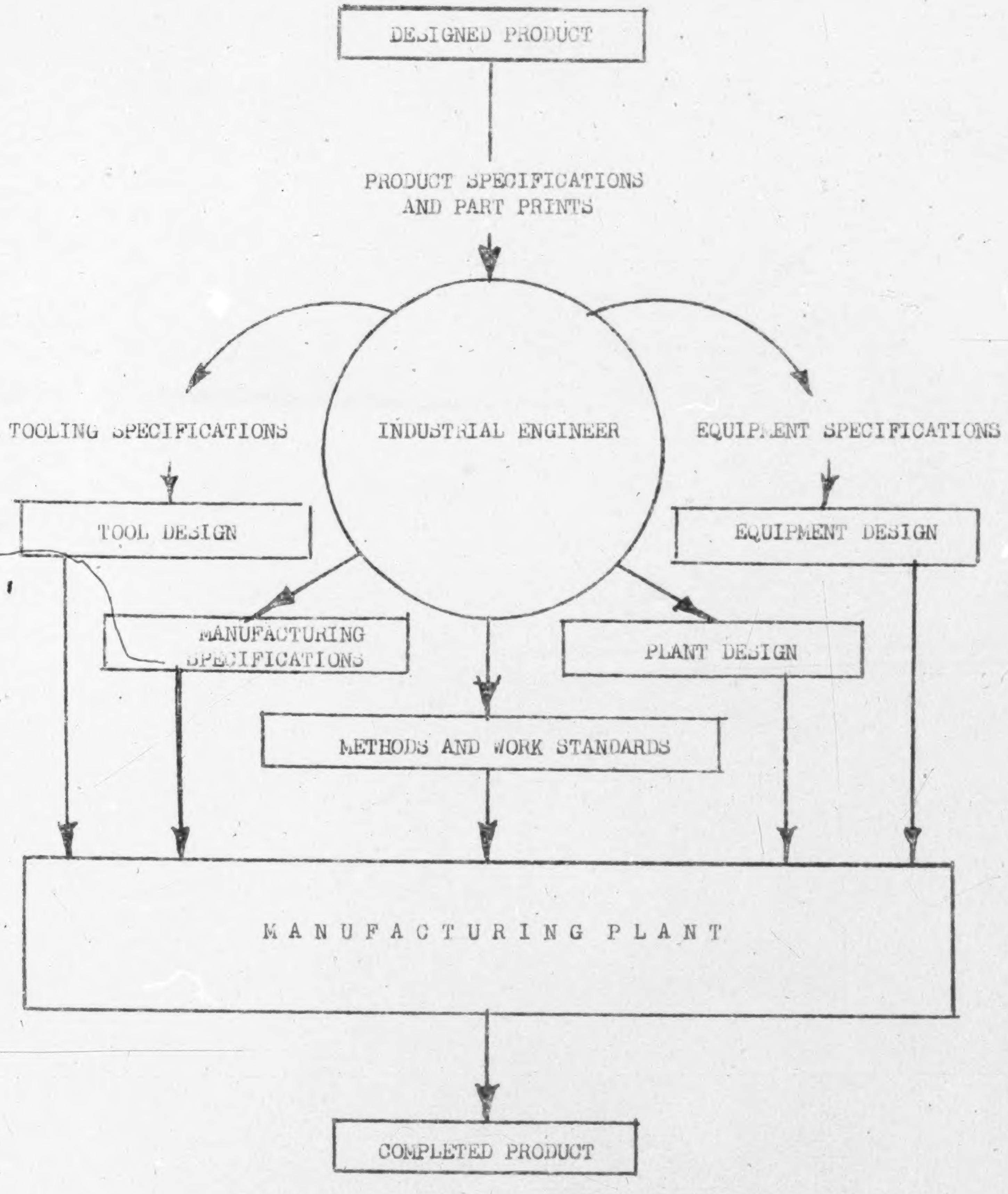

DESIGNED PRODUCT
PRODUCT SPECIFICATIONS AND PART PRINTS
TOOLING SPECIFICATIONS
INDUSTRIAL ENGINEER
EQUIPMENT SPECIFICATIONS
TOOL DESIGN
EQUIPMENT DESIGN
MANUFACTURING SPECIFICATIONS
PLANT DESIGN
METHODS AND WORK STANDARDS
MANUFACTURING PLANT
COMPLETED PRODUCT

FIG. A. ACTIVITIES OF THE INDUSTRIAL ENGINEER

Before a product is manufactured, the Industrial Engineer must find the answers to a number of questions. Examples of these questions are: (1) Can we manufacture this product? (2) What materials do we use? (3) What tools do we need? (4) What machines do we need? (5) Do we make all of the product or just part of it? (6) What will be the production schedule for this product? (7) Are there any hazards involved in manufacturing? The Industrial Engineer will first examine the information given to him about the product. He will then use his own knowledge and the knowledge of others to figure out the best solutions to the problems.

Work methods that are good are important to the Industrial Engineer. Because, good work methods are the best and fastest way of doing a job. Any time a job can be made safer, easier, and more interesting, we know it should be done. Also, everyone must work together in a very cooperative way to make the job a pleasant experience.

Work standards are detailed and passed along by the Industrial Engineer, because a product must be made the way it was specified. We make sure of this by inspecting it. This is called quality control. If a good product is made, the company will be able to sell it, and sales mean profits.

Plant processes will be studied by the Industrial Engineer. Because a worker must be located in the best possible position to do his job efficiently. A flow chart is a map of where a product will go as it is being made. (Fig. B).

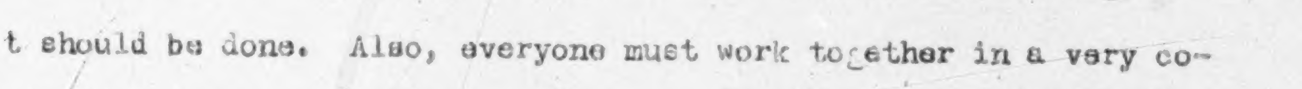


FIG. B. FLOW CHART

The use of a flow chart will help the Industrial Engineer recommend the best location for the workers and their machines.

Estimating is a statement of what certain work and material will cost. The Industrial Engineer must know enough about work and materials to be able to tell if the product can be made with a profit. We must always know, before we start the manufacturing process, if a product will be profitable.

Scheduling is very important, because if a factory promises a product at a certain time, it must meet the manufacturing deadline. Some products now are sold before they are made. This makes it necessary to have a time schedule which everyone must follow in order to complete the product. The Industrial Engineer must help work out this scheduling and see that it is followed.

The services of the Industrial Engineer are called upon when a large plant is to be built for manufacturing mass-produced items. Mass production is when a person will make a single part and other persons will make different parts, and these parts are all put together to make the finished product. Examples of mass-produced products are automobiles, washing machines, refrigerators, and television sets.

The Industrial Engineer is important to industry because he helps factories to operate more efficiently. Most factories employ Industrial Engineers as part of the regular staff. These engineers are continuously improving old methods and working out new ones.

SUMMARY

Engineering is the profession that puts power and materials to work for man. An engineer must know Mathematics, Science and English. He must also study to keep up with new engineering developments. An engineer is really a problem solver. He has special college training which will prepare him to work in a certain branch of engineering.

One branch of engineering is the Industrial Engineer. He must show the best way to manufacture a product. He must understand specifications, estimating, and factory processes. He usually works very closely with other engineers in solving the many problems created by industry. He will understand work methods, standards and design communication. He will know how to use estimating and scheduling to an advantage in manufacturing. He works with many tools and with every kind of material there is in the world. No matter where he is, or what he is doing, his main job is to make our world a better one for us.

LABORATORY ACTIVITY

OBJECTIVE. To understand design communication, specifications, and estimating.

Activity No. 1 - Design Communication

To understand design communication, each student should have three 1/4" washers with one 3/16" bolt and nut, one 1/4" bolt and nut, and one 3/8" bolt and nut. The exercise will be to have the washers put on each bolt. One will fit loose, one will fit correctly, and one will not fit at all. This should demonstrate the importance of complete information on the design drawings so parts will fit together correctly when assembled.

Activity No. 2 - Specifications

To understand specifications, each student should write a word. This could be a single word, or each student could have a different word from a sentence. Each student will have variation in the size and type of each word. Next the specifications should be given to (1) print the word, (2) use all vertical, capital letters, and (3) make each letter 1/4" high. This will illustrate the importance of having specifications before something is made.

Activity No. 3 - Estimation

To demonstrate the ability to estimate, each student should estimate the length of his pencil and the square inches of his desk top. Next he should measure with a ruler to compare an estimate to the actual length and square inches.

Activity No. 4 - Cost Estimate

To understand cost estimate, each student should complete the problem as to which would be the most economical method of drilling a 3/16" hole in 1/8" mild steel. This should be figured for 1, 10, 100, and 1,000 holes.

Method No. 1. Lay out each hole, center punch and drill. Set up time cost, $.50: completing job cost, $1.50.

Method No. 2. Make a jig, then center punch and drill. Set up time cost, $10.00: completing job cost $.10.

ORGANIZING

OBJECTIVES

1. To make one aware of manufacturing management practices of organizing an industry.
2. To make one understand the idea or concept of organizing.

INTRODUCTION

Athletic teams, businesses, scout troops and civic groups all have an organizational (a group that functions as a single unit) pattern. These patterns may vary in make-up but all have a common goal. The goal is to produce goods.

For example, let's take the school athletic program. The school has an athletic director, coaches, student managers and team players. Let's think of the athletic director as the President. His duties are to organize the athletic department. He schedules all games. He buys all athletic equipment. He arranges all special athletic events and coordinates all the athletic programs during the year. The athletic director is in charge of the entire athletic department.

Next in line is the team coach. We will call him the Vice President. He is responsible to the President. His duties are to organize the team. The baseball coach, for example, will designate the pitching staff, catchers, infielders and outfielders. He is the one who decides the player for the bases, shortstop, and the field. He also selects his student managers and may designate certain duties for them.

The word organization, as related to baseball, also is related to manufacturing. It means to give structure to the jobs of the people who are employed in industry.

STRUCTURE OF MANUFACTURING

The organizational structure of manufacturing deals with the over-all job pattern of the personnel (all employees) in an industry. The larger the industry the more complicated the structure becomes. Let's use for an example, the comparison of a harbor tugboat and a sea-going tugboat. Both of these vessels would need storage space for their gear, (necessary equipment) fuel, and water. The sea-going tug however, would need larger storage. This is because it would be out for a longer period of time. Its duties are greater than the harbor tug. Also the sea-going tug would need sleeping and cooking facilities. Consequently, the larger the vessel the more complicated it becomes as far as the planning of it is concerned. In the manufacturing structure you will note similar concepts.

A Line-Staff organization is the most common used in industry. (Fig. A).

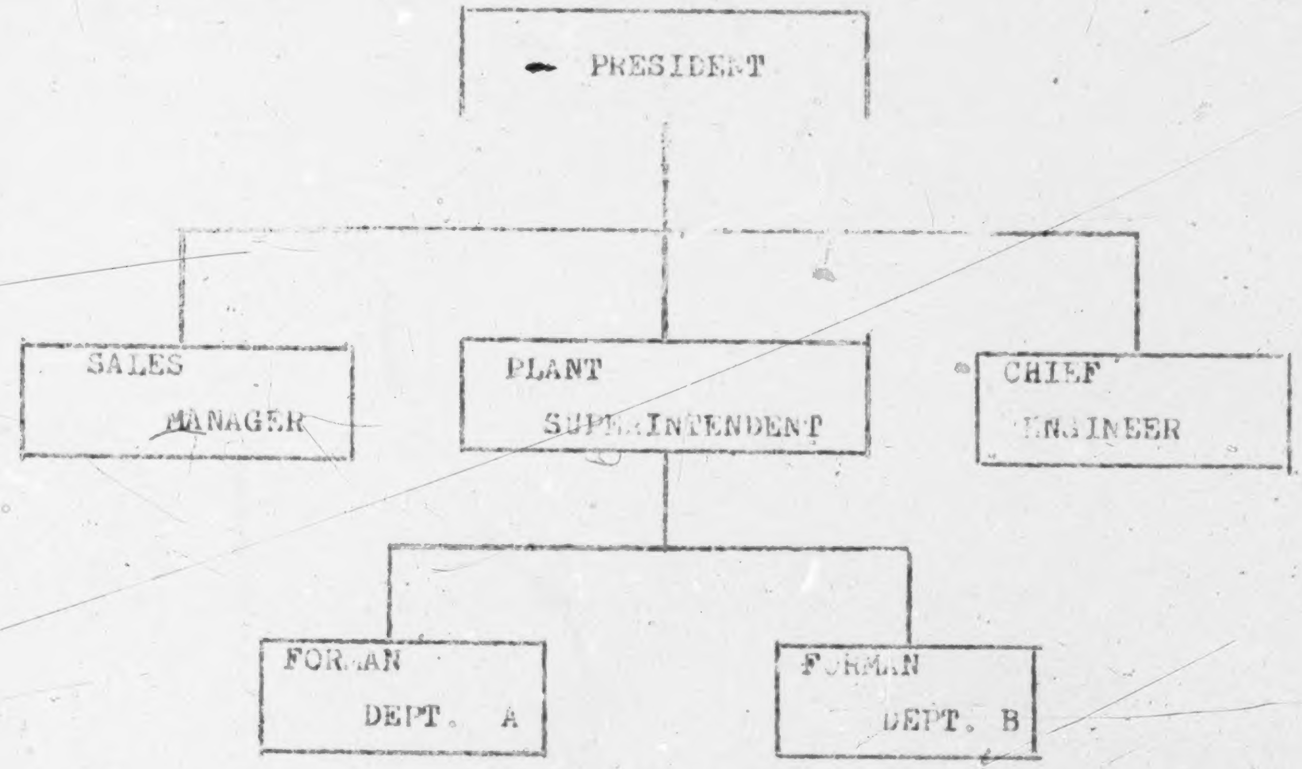

PRESIDENT
SALES MANAGER
PLANT SUPERINTENDENT
CHIEF ENGINEER
FORMAN DEPT. A
FORMAN DEPT. B

FIG. A A simple Line-Staff organizational chart.

ORGANIZING

In the manufacturing structure you will be concerned with:

1. Work Tasks: What is to be done.
2. Worker Functions: Who is going to do it.
3. Role of the Worker: What the job consists of and the skills required.
4. Setting Work Conditions: Adequate facilities (space , tools, and machines).

1. Work Tasks - Careful consideration must be given to all of the jobs to be done. Let's start with the top position in the industry. In other words use the "If I were president' approach to the problem. You then would make decisions on the various divisions of work to be done. This could be accomplished by setting up divisions and departments. By doing this you should group various tasks together. After making these divisions the authority given to them must be considered. A division should be responsible for only one primary function. Its secondary functions may be organized into departments. (Fig. B).

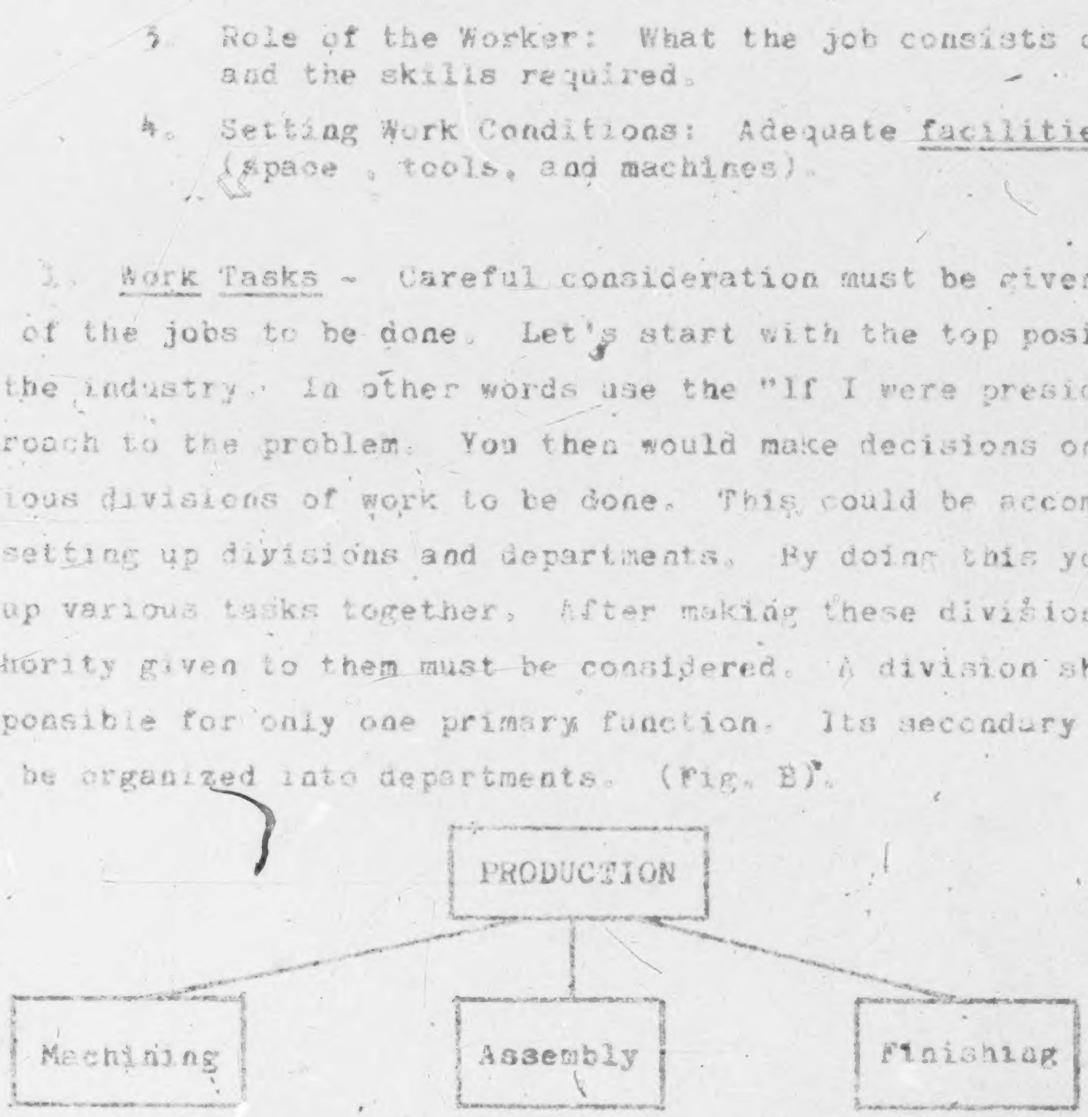


FIG. B. A Department and its Divisional breakdown.

2. Worker Functions - Industrial engineers and personnel working together should analyze both management and worker jobs. This group should determine physical, mental, and needed skills to do the job. For example, a worker driving a fork-lift truck to move materials need not be exceptionally strong. A worker who must load and transfer heavy materials from one place to

another by means of a wagon or cart would need to be strong.

3. Role of the Worker - Both the management worker and the labor worker need to know what his job requires of him. They need to also be aware of the relationship of their job to other jobs. Understanding this relationship, each in turn will have an appreciation of their job responsibilities.

4. Setting Work Conditions - Adequate facilities are of prime (first) importance to good working conditions. Facilities may be divided into two parts. One part being space to do the operation. Crowded space is not desirable for good, safe, and pleasant working conditions. The other part is, up to date tools and machines to do the job. Old tools and machines will not add to the morale of the workers. A high morale within the entire organization is very desirable.

SUPPLYING IN MANUFACTURING

Supplying consists of purchasing needed materials or articles from outside sources. These are needed to manufacture a product. Also the routing and storing of these within the manufacturing facility is part of supply. (Fig. C).

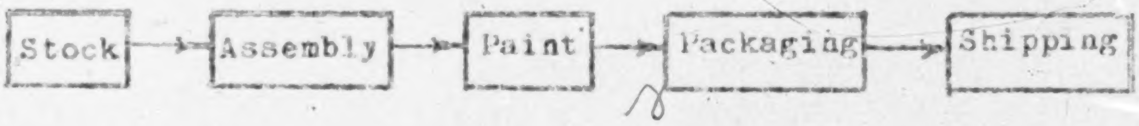


Fig. C. A Flow Chart for materials in a plant.

Requisitioning and Purchasing - All supplies must be requisitioned so that proper accounting methods will be satisfied. This requisitioning is done by appointed members of the various departments or divisions involved in the organization.

Generally speaking a manufacturer will spend at least half of what he takes in for materials and sub-contracted parts.

ORGANIZING

In a 1960 report, the Ford Motor Company spent $10 million daily for materials and outside parts. The purchasing department is responsible for all the materials to be used in the manufacture of the product.

Procuring and Sub-Contracting - Contacts must be made to find competitive suppliers for materials needed. One must make sure that the source of supply is adequate. Also that the price quote is reasonable. More than one price quote is desirable. Also more than one supplier is usually a good idea. A Ready Mix concrete company would want to buy sand and gravel from more than one supplier. This promotes good public relations between companies.

In some instances due to lack of facilities and or machines it may be desirable to Sub-Contract (let another company build the part) some of the parts needed for the product. These parts will have to be requisioned and delivery dates agreed upon. Requisioned means to request or ask for. For example, a manufacturer of air conditioners may find it cheaper to buy electric motors from a motor manufacturer. This is because it would be too expensive for them to buy the needed equipment necessary for them to make their own.

Storing and Routing - The materials from which the product will be made must be stored somewhere the plant facility. There are two types of storage used. One is centralized storage. The other is in-process or spot storage. Centralized storage is having all supplies stored in one area. From this area supplies are transferred, usually by conveyors, as they are used. In-process storage is where materials or component assemblies are stored where they are to be used. More often than not industry uses a combination of these two types of storages.

Routing is done by a variety of methods. Namely conveyors, turntables, fork-lift trucks, carts, hand trucks and shutes.

ORGANIZING

Routing is the movement of materials through the plant as the product is being assembled to its finished form.

SUMMARY

A workable "organizational pattern" is essential to a manufacturing company. The "organizational structure" deals with the over-all arrangements in the company. A manufacturing organization is a group that functions as a single unit. No human group activity is ever really successful unless it is organized. If all personnel have a thorough understanding of their jobs this will strengthen the organization.

ORGANIZING

LABORATORY ACTIVITY

Objectives

1. To enable the student to perform some management practices used in manufacturing.
2. To set up a Line-Staff Organization in this class.

You have read and discussed the over-view of the organization and structure of manufacturing. Today we will organize a company.

On the chalkboard is an example of a Line-Staff Organizational Chart. We will fill it in with your names. Volunteer wisely for a division that you are interested in. We possibly will, at a later date, use this in the manufacture of a product in this class.

In your Industries notebook sketch or draw the diagram on the board. Make the boxes large enough so that you may insert names.

Materials Needed

Notebook - Pencil - Ruler

Procedure

We will list the Primary job for each of these boxes and then select a volunteer for the job.

CONTROLLING

OBJECTIVES

The student, upon study of this unit, should be able to:

1. Know and relate functions of the personnel in the control department in a manufacturing plant.
2. Tell some of the methods used in controlling production as to; the accuracy of the work, the efficiency of the process, increasing production, decreasing the cost.
3. Observe how control interacts with other areas of management and production to see that the service or the product being produced is satisfactory in all respects.

INTRODUCTION

Industry needs some way to make sure the things being made are good. This part of management is called control. Control means to hold back, to adjust, to regulate. The ways used in controlling are; supervising, monitoring, reporting and correcting.

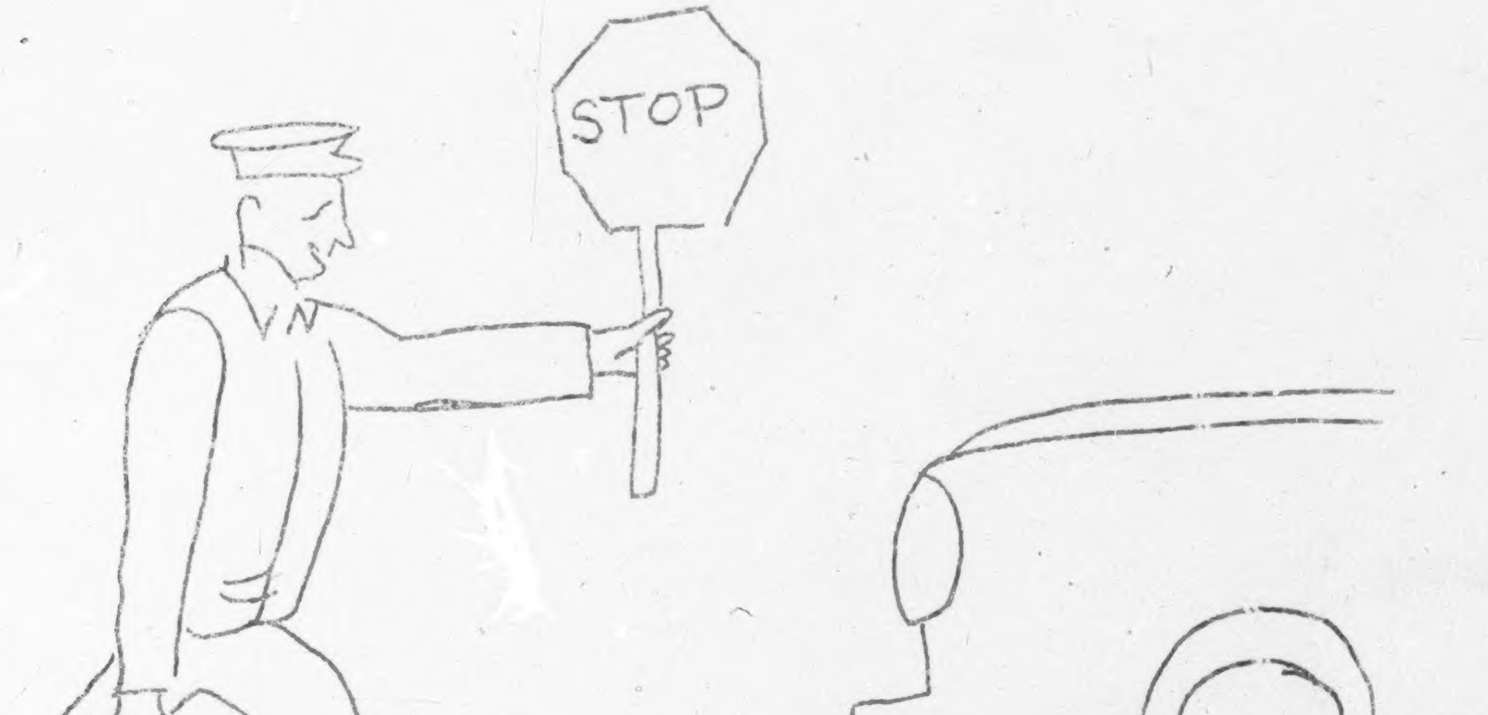


FIG. A Policeman directing traffic

SUPERVISING

Some of the people in the control part of management are the supervisors. Sometimes these men are called shop foremen. He is the connecting link between higher management and the workers. He gives the orders and instructions of the management to the workers. He gives notices of pay raises and of process of pokicy changes. It is his job to give direction.

Directing (Fig. A) is the way of issuing instruction to the workers on what should be done. Directing is an essential step in supervision. Without directing nothing would happen. Instructions should be reasonable in that they can be done. They should also be clear and complete. These types of instructions will make for better coordination between management and labor.

Coordinating is the unifying and intergrating of the employees activities to obtain industries production goals. As an organization becomes larger the task of coordination becomes more complicated. Communication is the means of obtaining coordination. Lack of understanding between the departments leads to poor coordination. The modern manufacturing plant is divided into a whole seris of units. Each unit is concentrating on only one part of the total operation. Through proper communication the parts on the assembly line will end up in the right place. These parts have to be checked. This leads to the monitoring phas of controlling.

MONITORING

Controlling needs some way of finding out when something is wrong. Monitoring is the way it is done. Monitoring means to check or test something. This is usually done by inspecting, inventorying and timekeeping.

Look around you at the different items that have been manufactured. Notice that most are made up of many parts. Each part way designed and built to certain specification. A part on one product is the same as the corresponding part on another identical product. These parts are interchangeable. This means that any part selected will fit with any other mating parts.(Fig. B) The credit for this idea is given to Eli Whitney. He used this concept in 1798 for the making of firearms. This concept along with the idea of progressive assembly has given rise to the mass production system.

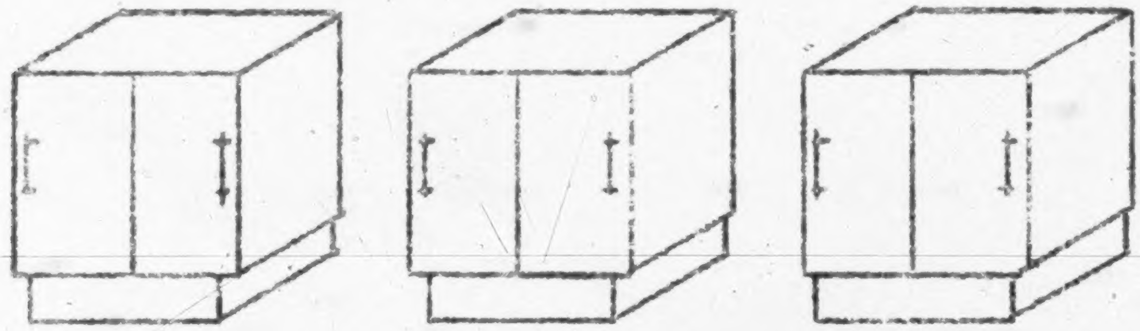


FIG. B Controlled Production: Massed produced cabinet with interchangeable parts.

Each part produced has to meet certain required specifications. To make sure these parts meet specifications they are inspected. The person who checks these parts is called an inspector. His job is to see that the part is made within certain limits called tolerances. It is impossible to make thousands of parts exactly alike. There will be variations in making the part. Tolerance is the allowable error in the size of a part. Tolerances may be both plus and minus, or on both sides of the basic size dimension, they are termed bilateral tolerance (Fig. C) Tolerance may be on one side only, it is called unilateral tolerance. (Fig. D)

CABINET DOORS

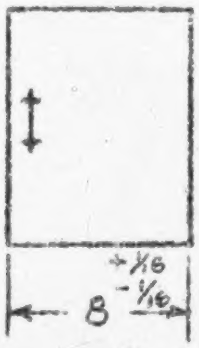


FIG. C Bilateral Tolerance

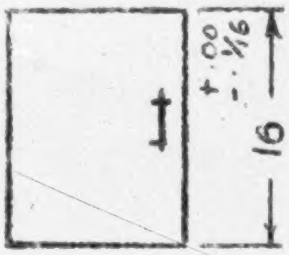


FIG. D Unilateral Tolerance

The inspector in quality control checks size, volume, weight, construction, color, surface and completeness of manufacture. He checks The part by measuring with different instruments. These may be a rule, a gauge block, or a micrometer. (Fig. E). Or he may use a limiting gauge called a check fixture. A check fixture is a device which shows the inspector whether the part is within an acceptable tolerance. An example of a simple check fixture may be seen in the second laboratory activity.

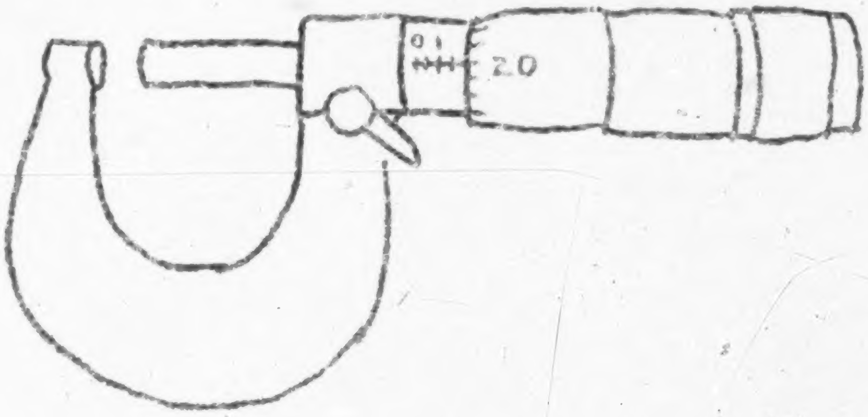


FIG. 2 A Micrometer: Used in determining thickness of material or a part. Can be read to .001 on an inch.

Sometimes it is not practical to inspect each part. This maybe due to an extra high number of parts being produced and the amount of cost of the defective item is low. An example of this would be the production of screws, washers, nails, or other small items. The workman would probably do his own inspecting. Random sampling is done where there is destructive testing. This would be in the area of welds. They are tested by pulling them apart.

Inspection can and does occur at any spot on the assembly line. However, there must always be a final inspection. This is done when the product is complete and before it is packed. Sometimes with a little reworking the product can be made acceptable. If it can't be made acceptable then the item should be thrown out. No inferior item should ever be packed and sent to the distributor.

Although supplying is part of the organizing branch of management, control also cooperates in inventorying. The inventory in a factory usually means how much material is on hand. This material may be raw material as in the case of the steel mill where it would be iron ore, coke, and limestone. It also can be manufactured supplies such as sheet steel, screws, bolts and other items.

Production depends on control to check the supplies and tell the purchasing department when and how much more to order. Control also inspect the quality of the incoming suppleis.

Timekeeping is another important function of monitoring. It is the process of keeping track of the employee's time in the factory. In a small plant where there are few workers this could be part of the foreman's job. In larger plants they usually have a punch card system. (Fig. F) This system requires each employee to have a card. The card would either have his name or an identifying number. Upon entering the plant he would pick up his card and put it in the time stamping machine. This would stamp the time on his card. He would do this again when he left. The timekeeper keeps track of the employees hours. In most plants employees are paid by the amount of time spent in the plant.

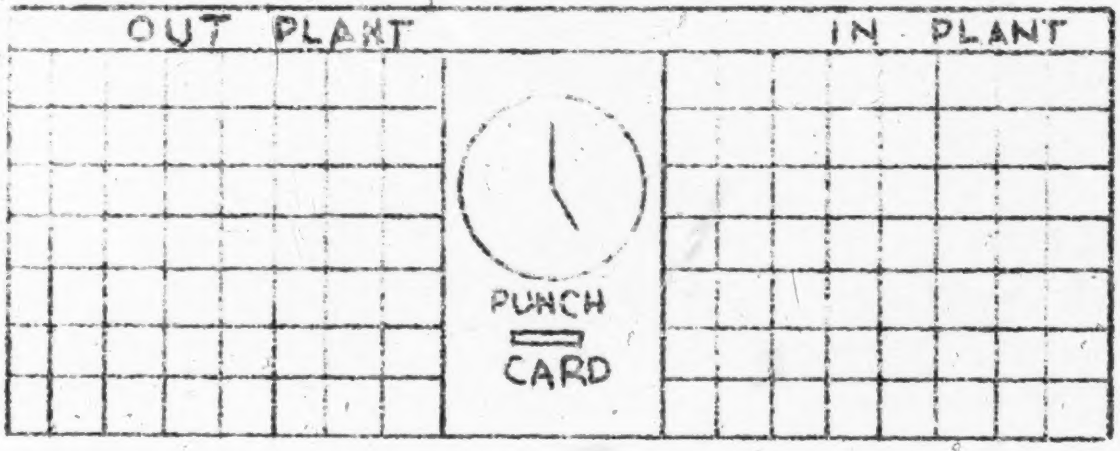


FIG. F Workers time cards:

Wage is the money paid to an employee. Usually the more difficult the job the more money the worker gets. The jobs are usually evaluated by a committee. The committees are usually made up of higher management, industrial engineers, personnel, and industrial relations people and union representatives.

REPORTING

To be effective the head controller or the man in charge of the controlling department has to know what is going on in the entire plant. Only then can he issue any corrective changes. The people who do the reporting may be liaison clerks, inspectors, quality control people, and status clerks. Compiling, appraising and notifying are means of reporting.

Compiling is the act of collecting together the material and data for presentation to the controller. This may be done by recording gauges, by various charts, or even by the use of computers. Computers are being used more and more. They are quicker and more accurate than any other means of reporting.

After compiling the data the controller has to appraise or determine how the different areas are functioning. If there is a malfunction in the machinery or some parts are substandard the controller has to make a corrective change.

The correction is sent to the man on the line through the supervisor or shop foreman. This is called notifying. Sometimes the worker catches the small error himself. Then he corrects the error before it gets too bad. Other times he may not know of the malfunction. The controller then has to catch the mistake or malfunction from the data that has been gathered.

CORRECTING

The phase of control called correcting is probably the most important step in control. This step is where control will have an affect on production. The other two basic steps in controlling; monitoring and reporting, are merely a preliminary. Usually there is something wrong. Somewhere the results did not com up to the expectations. The established objective and the standards were not met. Control corrects the substandard performance and results by adjusting, expediting, replanning, redirecting and retraining.

Adjustment may occur anywhere there are variables (subject to change) present. Adjusting a machine so that it works better. Or so the tool life is longer.

Sometimes in the manufacture of an article, it is found that a new tool, jig, fixture or part is needed quickley. The expediter is the man wo sees that the article is given tip priority or first consideration. This function is called expediting.

There are a few cases where the part was designed wrong. Control then works with designing in replanning the part.

There is corrective action in making sure the individuals are properly directed. Inadequate direction can be one of the reasons in not meeting the standards. The supervisor needs to review with the worker the way to accomplish or meet the standard. The supervisor is redirecting the worker.

The difficulty in meeting the standards may be more than misunderstanding. The worker may lack the necessary training or experience for his assignment. The worker needs retraining. (Fig. G). The man should be provided with the training as soon as possible. After a reasonable amount of time the worker should be working up to the standard. If he doesn't, he then should be reassigned.

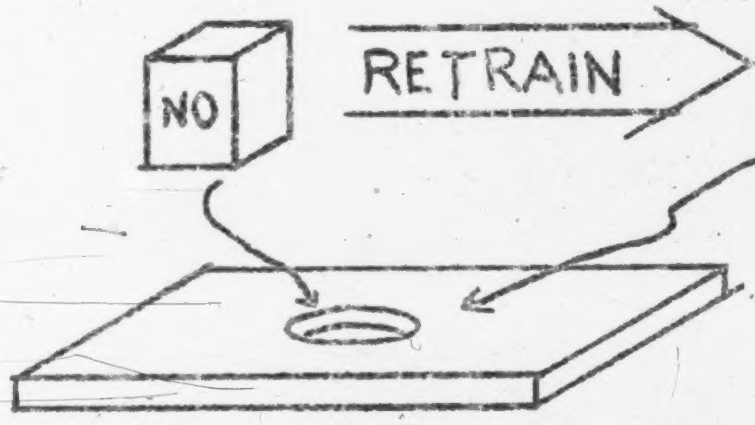


FIG. G Retraining: An analogy of how retraining helps the employee to fit the job.

The whole idea behind the manufacture of products is the making of a profit. Without a reasonable profit the factory would discontinue to operate. The profit motive is behind almost every action.

There are many different factors which enter into the cost of a product. The basic costs are usually determine by the planning section of management. That would be the materials and the processes used to manufacture the item. Cost controlling is concerned with the day to day operating decisions that affect production costs. The supervisor has some control over costs. He has some influence as to the utilization (use) of raw material and the amount of scrap produced. He tries to keep idle time to a minimum. Detailed assignments to men and machines are his responsibility.

Cost improvement can come anywhere. Improving the conditions and simplifying the process can improve costs. Sometimes the man on the job can find a simpler way of doing the operation. Usually most companies will reward an employee for his ideas.

SUMMARY

Contrulling means regulating, restraining, or to exercise authority over. This is done in industry by supervising, monitoring, reporting, and correcting.

Supervising is carried out by directing and coordinating. Directing is issuing instruction to the workers. Coordination is unifying and intergrating the employees actions to gain an objective.

Monitoring is the method of checking or testing something. This is done by inspecting, inventorying and timekeeping. Inspecting is to measure or check to see if an item is within an acceptable tolerance. Inventorying of supplies is a check on how many supplies are on hands. Timekeeping is the method of keeping track of employees time in the plant. His wages are based on the hours spent in the plant.

Reporting is the means by which the head controller is kept informed. Compiling, appraising, and notifying are the means of reporting. Compiling is gathering the data together to present to the controller. Appraising happens after the controller receives the data. After reading the data he has to determine what course of action is to be taken. Notifying is the process of letting people know of the action to be taken.

Correcting is what control does after the basic preliminary steps are finished. This is done through adjusting, expediting, replaning, redirecting, retraining and cost controlling.

ACTIVITY

Objective

1. Learn to read a rule to the nearest 1/16".

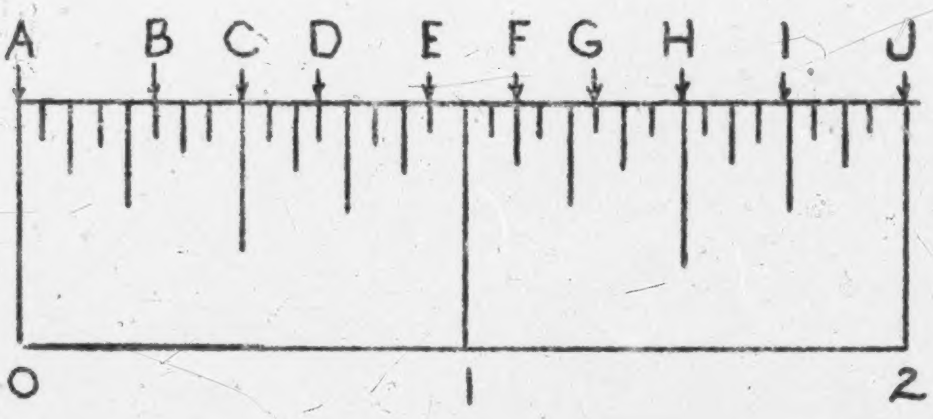
Activity #1 Reading a ruler

All of the working drawings have dimensions on them. The dimensions are numbers showing you the size of the part. To build the part you must be able to read a rule accurately. The following exercise will give you some practice.

Procedure

Fill in the blanks listed below.

1. A-B ______
2. A-C ______
3. A-D ______
4. A-J ______
5. A-E ______
6. A-I ______
7. B-E ______
8. B-G ______
9. B-I ______
10. C-E ______
11. C-J ______
12. D-G ______
13. D-J ______
14. E-G ______
15. E-H ______
16. F-I ______
17. G-H ______
18. H-J ______



Objectives

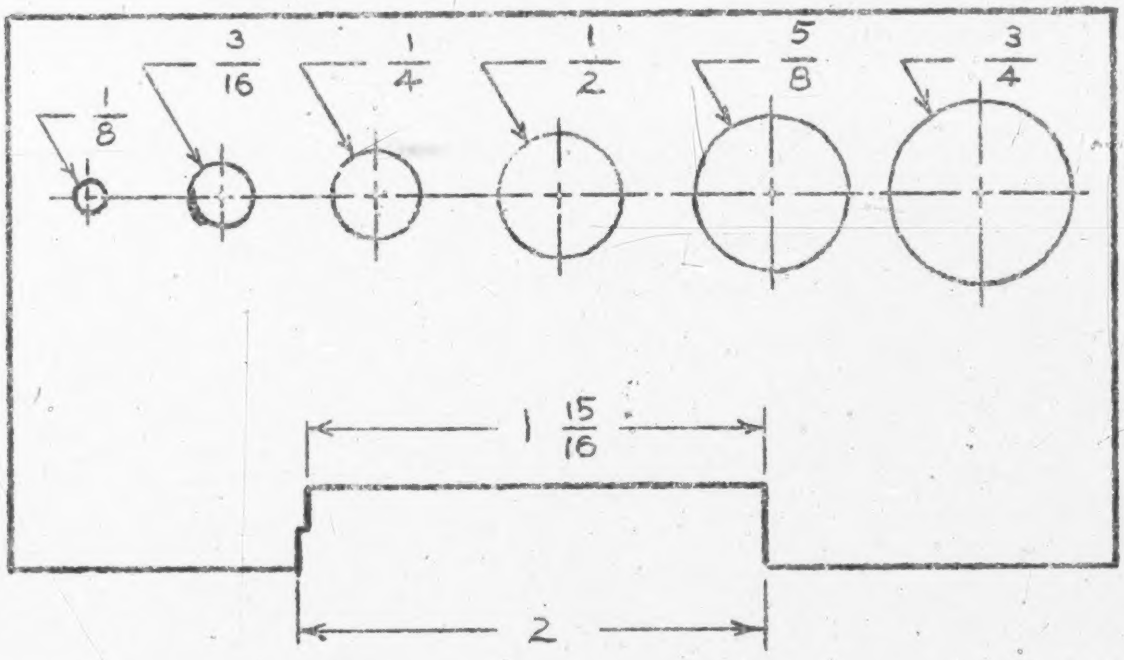
1. Learn how a check fixture is used.
2. Learn how much faster a check fixture is than measuring.

Activity #2 Inspection with a check fixture.

One important tool in inspection is the check fixture. With the use of check fixtures the measuring is made much easier.

Procedure

In the box are 200 pieces of dowel rod. They are approximately two inches in length. Their diameters range from 1/8" to 3/4". Your job is to sort the dowels into groups having the same diameter. The dowels have to be larger than 1 15/16" but less than 2" long. It should be done in less than five minutes after the fixture is complete.



PRE-PROCESSING

OBJECTIVES

After studying this unit you should be able to:

1. Define pre-processing related to manufacturing.
2. Define receiving, unpacking, handling, storing and protecting as activities of pre-processing.
3. Identify common types of handling equipment.
4. Identify the goals of pre-processing.

INTRODUCTION

Have you ever wondered how something is made? Your bicycle, for example, is made up of hundreds of parts. Each of these parts had to be manufactured. Production is the story of how materials become useful products.

In the making of your bicycle, materials are changed into fenders, handle bars, spokes, and many other parts. We call this action processing. Repairing your bicycle and keeping it in good condition are post-processing activities. These activities take place after the product is made. But what happened before these changes took place? How did the materials arrive at the machines which changed their form?

PRE-PROCESSING

Some things like tires and lights may be purchased from another company. Steel, aluminum, plastic, paint, and other materials and supplies are needed. These materials and supplies must be received, unpacked, handled, stored, and protected. We call these activities pre-processing. Now let's find out what each of these activities includes.

RECEIVING

The many supplies arrive at a variety of manufacturing industries by land, by sea, and by air. These supplies may be the grain for your favorite cereal, the plastic that will soon become part of a new telephone, the logs that will become paper, or the steel for a new car. There are countless other materials, parts, or supplies. Most items arriving at the docks of today's factories come by rail and by truck. It is the job of receiving to unload and check the quantity and condition of the goods. A receiving clerk prepares a receiving report. It is used to up-date the records in purchasing and in the storage area. From this point it becomes the job of the store clerk to take charge of the goods.

PRE-PROCESSING

Some manufacturing companies have separate receiving rooms. There, the goods are unloaded, unpacked and inspected to insure that the items ordered were received and are in good condition. Other companies receive goods directly in the store room or in storage areas near where the goods will be used. When possible, unloading of rail cars and trucks takes place inside the building. (Fig. A) Notice that the roadway is below the dock. This makes unloading much easier.

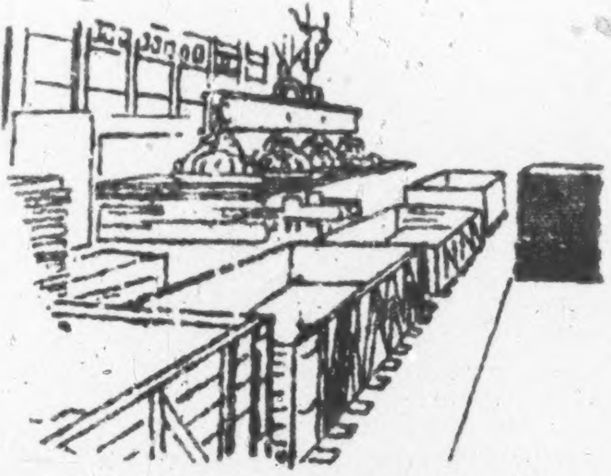
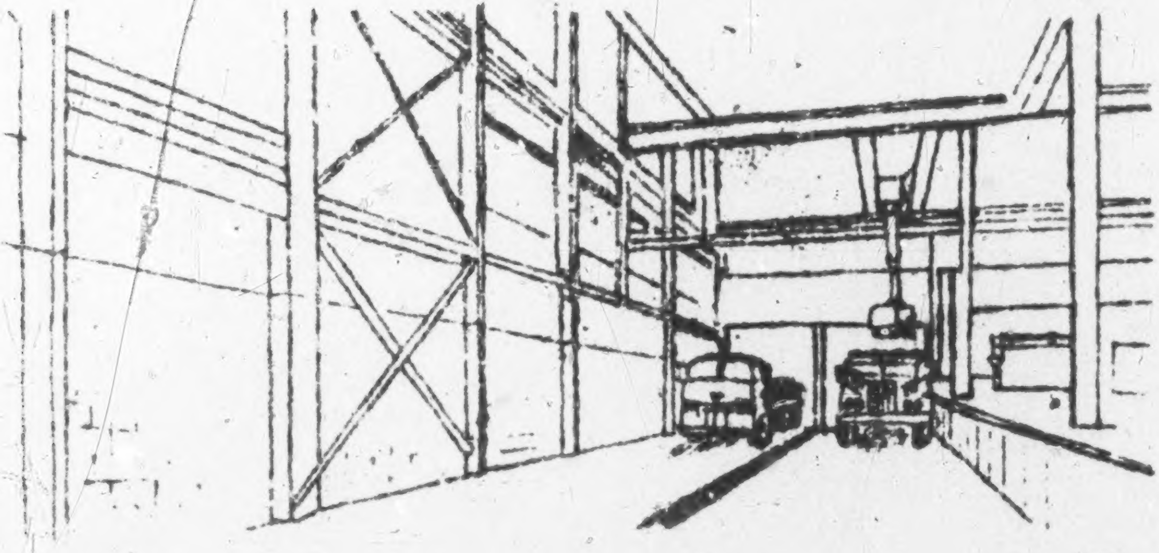


FIG. A

Use Of Magnetic Crane



PRE-PROCESSING

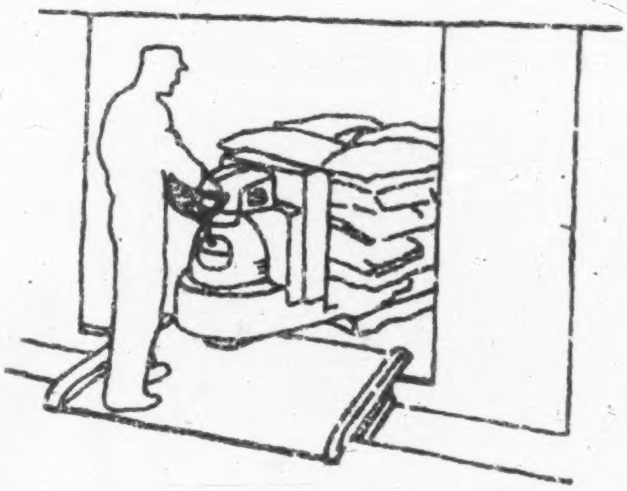


FIG. B Ramp

A simple ramp assists greatly when unloading railroad box cars and trucks. (Fig. B) Grain requires a very different type of unloading. Tank trucks deliver grain and a flexible pipe is attached to the truck. The grain is then sucked through the pipe into large storage tanks. Man's desire for improved ways of doing things has speeded up the receiving operation. Many trucks have their own unloading equipment:

(Fig. C)

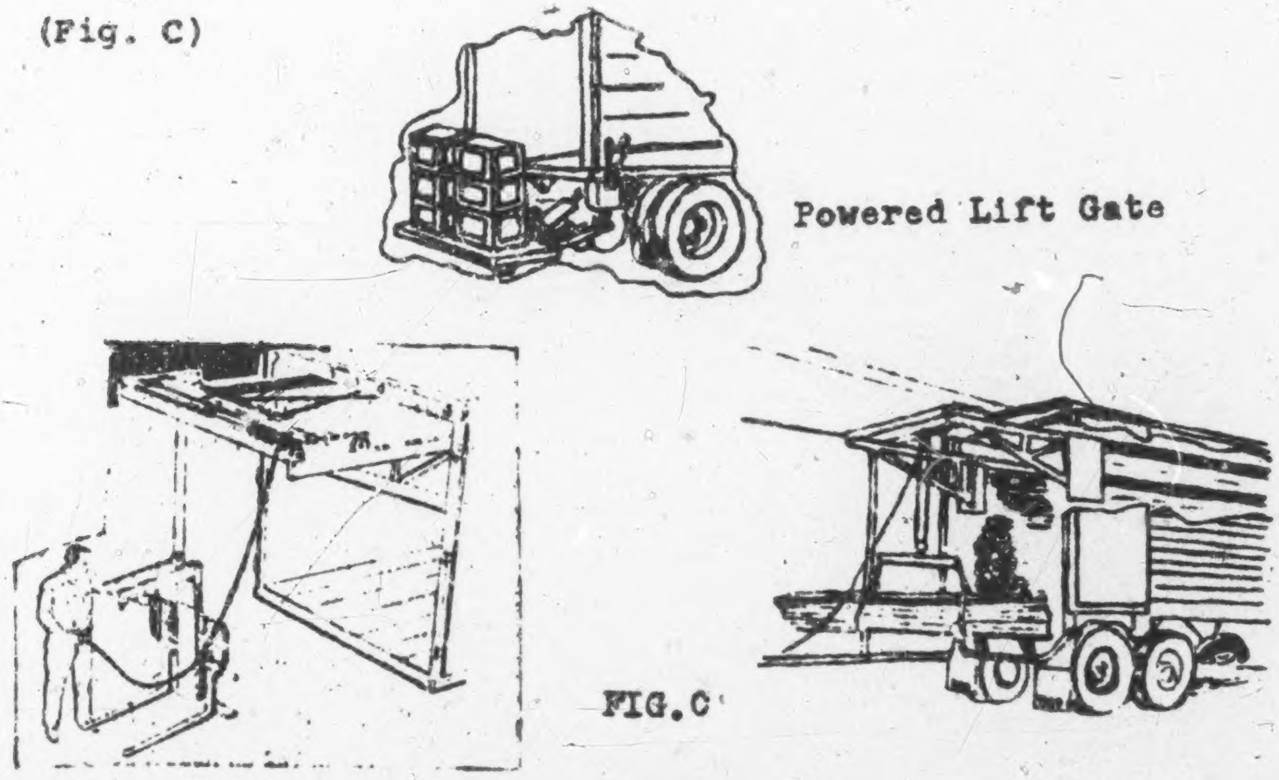


FIG.C

PRE-PROCESSING

UNPACKING

Removing goods from their shipping containers is really a part of receiving. The container in many cases is the truck, rail car, or boat that delivered the goods. For example, the tank truck was the container for the grain mentioned before. As we think of it, unpacking is, therefore, not always a necessary part of pre-processing. Other materials are packaged for protection. It makes them easier to handle and they must be opened to take out the contents for inspection and storage. Unpacking may or may not be a big job. It depends on the type of things being received and the size of the factory.

HANDLING

Eating, moving furniture, and carrying groceries are everyday examples of material handling. Industrial materials must also be handled. Materials handling personnel and equipment are on the move from the moment materials arrive until they are changed into useful products. Materials handling is an expensive operation. Up to half of a company's total labor cost is for materials handling. These costs cannot be regained.

PRE-PROCESSING

Wise management of materials handling is often the key to success. Pre-processing handling is all handling that takes place before the first machine begins to change the form of the material.

Guides for Material Handling. Material handling is so important that a great deal of time is spent trying to find better ways. The following things help to reduce material handling time:

1. Move material over the shortest possible distance.
2. Avoid changes in direction, if possible.
3. Keep the storage time short.
4. When possible, use all equipment to keep materials moving.
5. Group materials in unit loads of large constant size-pallets, piggy back, standard containers. (Fig. D)
6. Carry load both ways, if possible.
7. Avoid partial loads.
8. Clearly mark and label materials and location.
9. When possible, eliminate handling.
10. Use mechanical or automatic handling when costs permit.
11. When possible, use the force of gravity to move materials. (Fig. E)

PRE-PROCESSING

12. Use equipment that can do more than one job.

13. Move material as fast as possible.

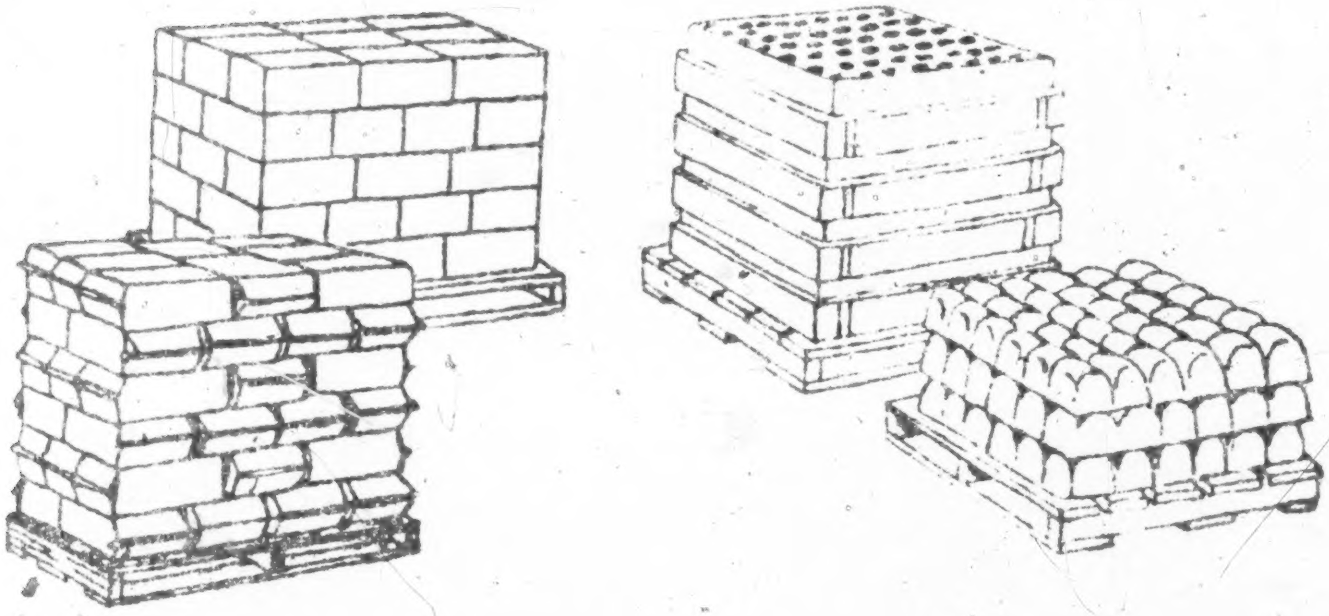
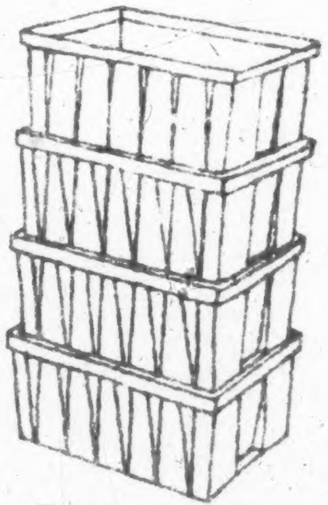


FIG. D Unit Loads On Pallets



Piggy Back
Standard Containers

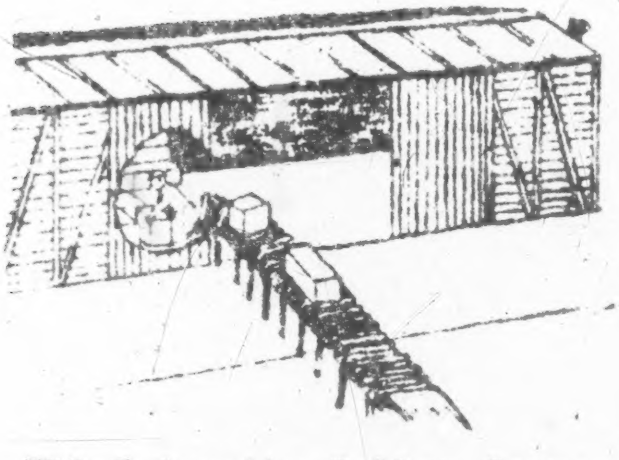


FIG. E Gravity Roller Conveyor

FILMED FROM BEST AVAILABLE COPY

PRE-PROCESSING

Materials Handling Equipment. Industry moves a wide variety of materials. Some are in the form of liquids; others are solids. To move these supplies each may require a different type of equipment. For example, you would not eat ice cream with a knife or spread butter with a fork. Materials handling equipment is designed to handle particular types of material. Let's discuss what must be considered in the selection of the right equipment.

What has to be moved? How much has to be moved? How far must it be moved? Will materials handling equipment be able to operate in the available space? These are all questions that need answers before we can choose the right equipment.

There are really two types of equipment. Fixed path equipment is built into the building. It includes such things as elevators, conveyors, certain cranes, and pipe lines. (Fig. F) Mobile equipment may be moved to any location. Examples include stackers, fork lifts, hand trucks, and warehouse tractors. (Fig G)

PRE-PROCESSING

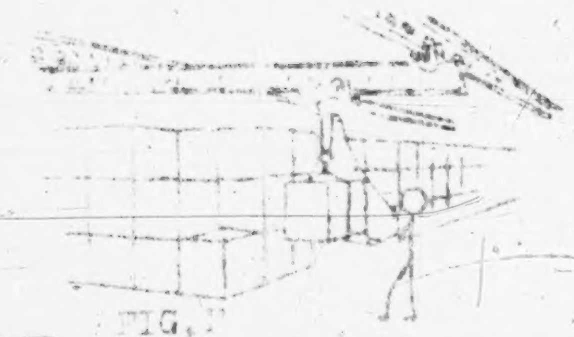
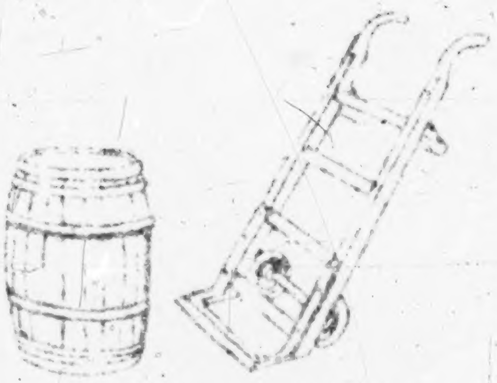
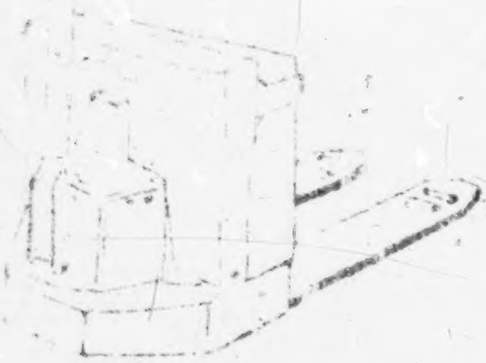


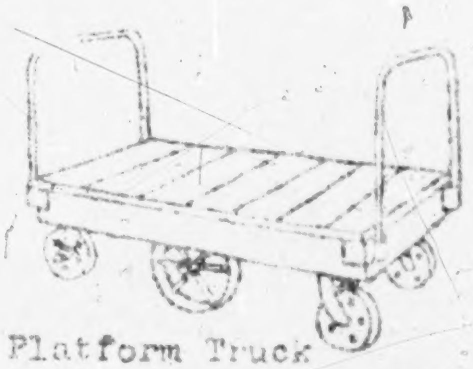
FIG. F
Fixed Path Crane



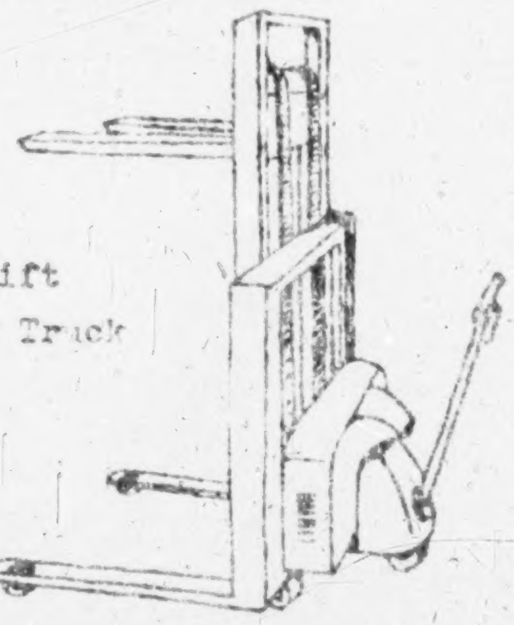
Hand Truck



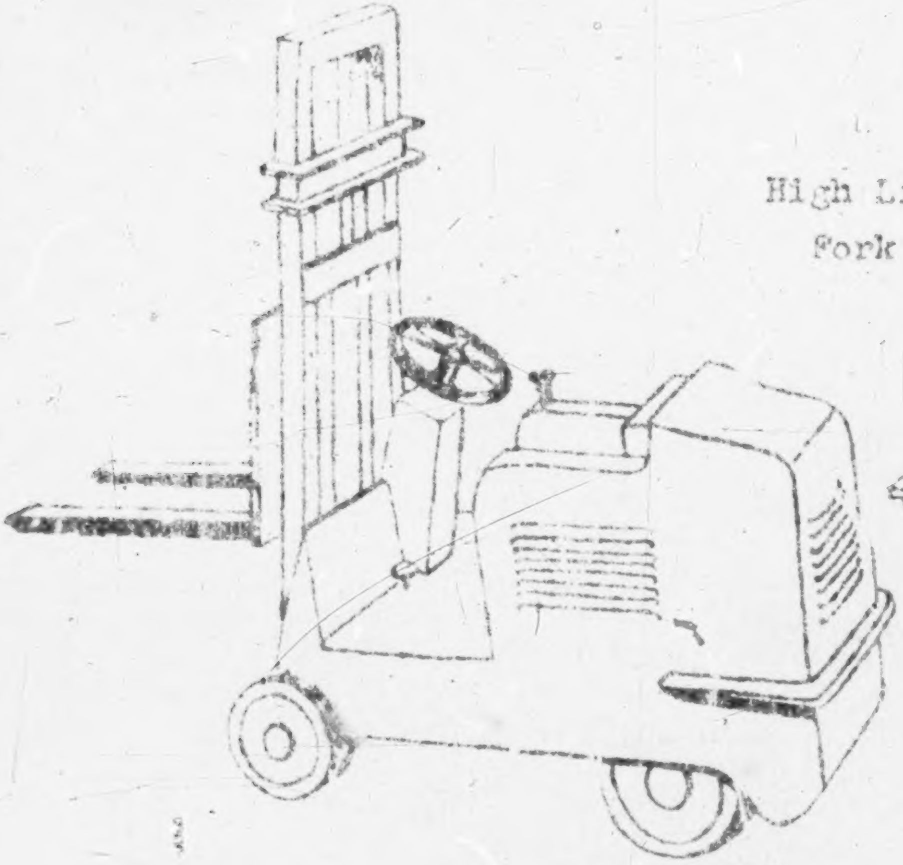
Low Lift Pallet Truck



Platform Truck



High Lift
Fork Truck

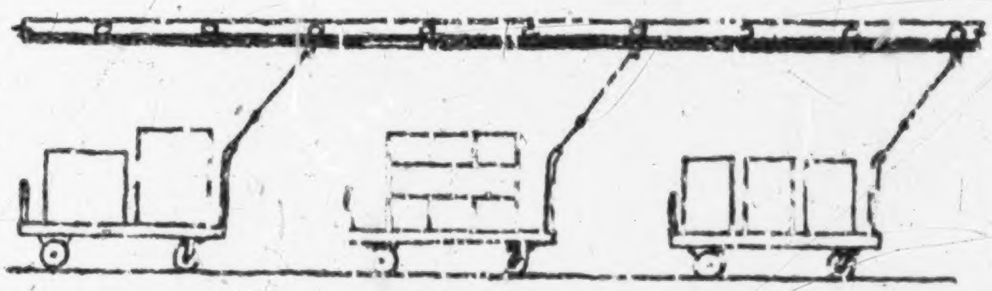


Fork Lift Truck

FIG. G

PRE-PROCESSING

Conveyors provide continuous or stop and go movement of any material at any speed. They may be like the simple belt conveyor you have seen at the grocery check-out counter. There are many other types of conveyors. (Fig. H)



Truck Towing Conveyor

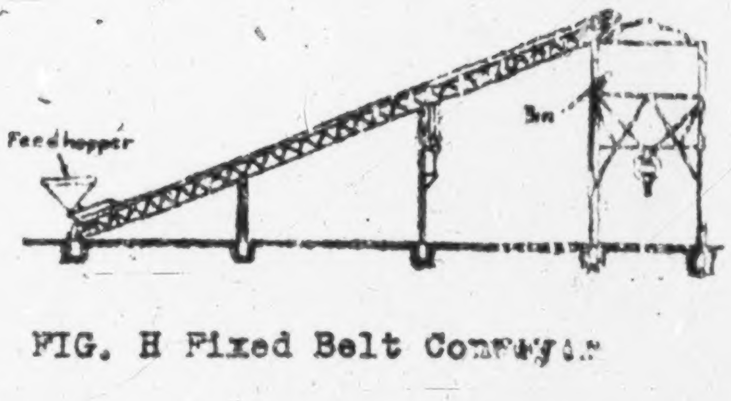


FIG. H Fixed Belt Conveyor

Cable Drag Conveyor

While conveyors can get items from one place to another, they cannot do all the jobs required to move materials.

PRE-PROCESSING

The stacker crane is an effective way of moving goods in and out of storage. It makes possible the full use of available space. (Fig. I)

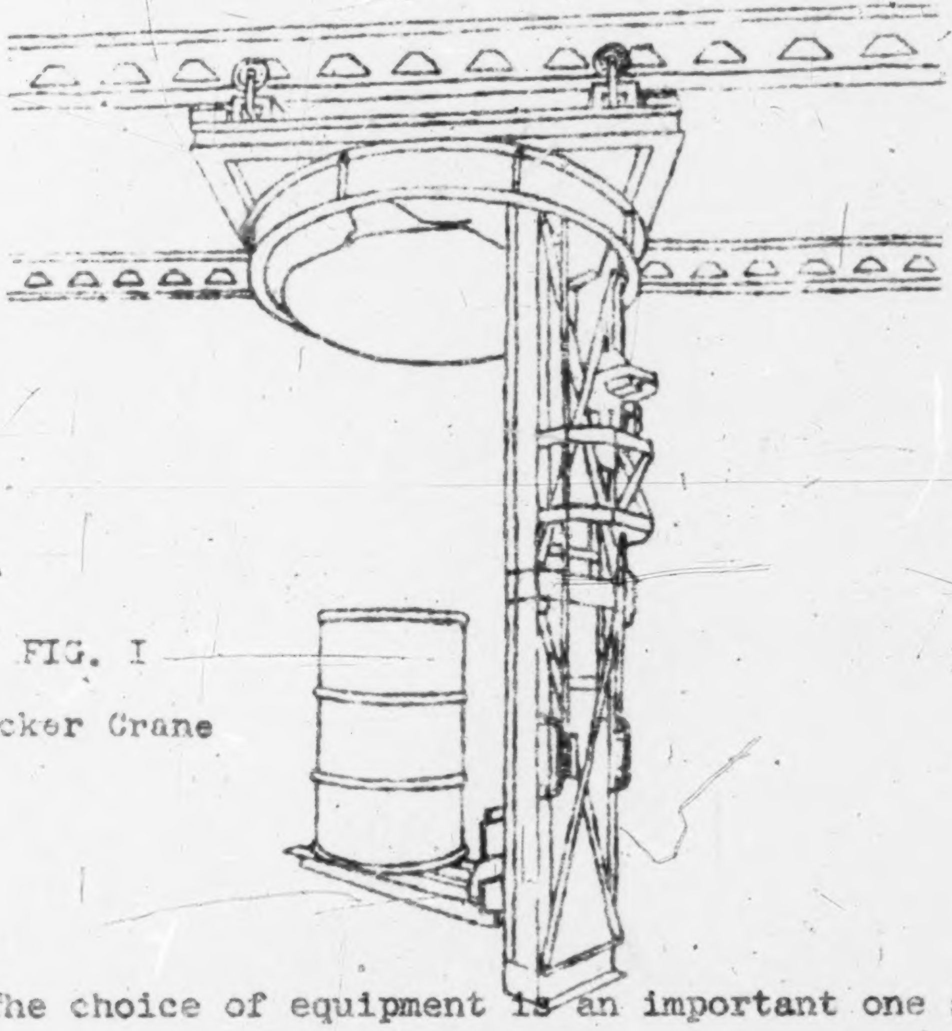


FIG. I

Stacker Crane

The choice of equipment is an important one since the handling of materials is the key to continued production. This choice must also meet the needs for the movement of materials in and out of storage.

PRE-PROCESSING

STORING

Space and labor are expensive. Whether the space is outside or inside, it is important to use it in the best way possible. It is also important to keep the handling and storage time short. Materials in storage do not make a profit for the company. They may also rust, spoil, or otherwise decrease in value.

The location of storage depends on the type of material, the rate at which the materials are used, and the space available. Materials should be stored close to where they will be used. Items should be grouped in unit loads. This requires the use of standard containers and pallets of equal size. (Fig. D)

We said earlier that the stock clerk accepts the goods from the receiving clerk. The stock clerk must see that the goods are placed in proper storage. It is important that the records show the quantity and location of the goods received. Each area and type of material must be clearly marked for identification.

PRE-PROCESSING

PROTECTING

Steel, fruit, grain, and glass certainly cannot be handled or stored in the same way. Each requires some form of protection. The steel will rust if left outside or where it is damp. Fruit will spoil quickly if not kept in a cool place. Insects and rats may get into the grain if it is not protected. Glass will break if it is not protected from heavy loads.

While protection for raw materials like coal may be little or none, things like fruit need special care. Temperature, moisture, exposure to possible fire and theft are important factors in the selection of a storage space. Each material has its own need for some form of protection.

SUMMARY

The success of a company may depend on the way materials and supplies are handled. Receiving, unpacking, handling, storing, and protecting are the functions of pre-processing. We have found that all these functions are closely related and that handling is an important part of each. Pre-processing goals that are signs of good management include:

PRE-PROCESSING

1. Receiving, handling, storing, and issuing items in the cheapest and most practical way.
2. Using warehouse space and labor to the best advantage.
3. Providing protection against fire, theft, and items becoming out-dated.
4. Keeping the quantity of items low.
5. Having needed items on hand at all times.
6. Having a good way to keep records of the quantity of materials in storage.

LABORATORY ACTIVITY

Objectives. As a result of this activity you will be able to:

1. make up unit loads on pallets.
2. make decisions as to how different materials might be handled.
3. Select the best storage for fruit, bolts, cement, and grain.

Activity. In out discussion of materials handling we found that it was important to group items in unit loads. Standard sized pallets are used as one way of making up unit loads.

It is the purpose of this activity to show you how various sized packages may be grouped for the best use of the pallet space. It also will give you an idea of some of the problems involved in handling materials.

8

You will be divided into groups of four students each. Each group will be given a 1/4 size model of a pallet. You will also get a set of blocks 1/4 the size of the package assigned by the teacher. Read the instructions for the chart carefully. (Fig. J) Once you have selected the pattern, try stacking your blocks on the pallet to see if they form a good unit load.

In connection with this activity you will be asked to answer the following questions:

1. What transportation might be used to deliver these packages?
2. What equipment might be used to handle these packages?
3. What type of storage and protection is necessary for the following items?
    a. Boxes of fruit.
    b. Boxes of bolts.
    c. Sacks of cement.
    d. Bags of grain.
4. What other ways are there of storing packages?

6	½	7	½	8	½	9	½	10	½	11	½	12	½	13	½	14	½	15	½	16	½	17	½	18	½	19	½	20	½	21	½	22	½	23	½	24	½
½	21	5	4	21	21	12	12	12	12	24	24	10	10	10	10	10	18	18	18	18	18	18	18	18	8	8	8	8	8	8	8	30	30	30	30	30	30
7		21	12	13	13	3	12	12	13	23	23	10	10	10	10	10	18	18	18	18	18	18	18	18	7	7	7	7	7	7	7	29	29	29	29	29	29
½			13	13	13	3	3	3	23	23	23	23	22	23	23	23	18	18	19	18	18	18	18	18	7	7	7	7	7	7	7	29	29	29	29	29	29
8				13	13	3	3	3	3	23	23	9	9	9	9	9	18	18	18	18	18	18	18	18	7	7	7	7	7	7	7	29	29	29	29	29	29
½					13	3	3	3	3	20	20	9	9	9	9	9	18	18	18	18	18	18	18	18	7	7	7	7	7	7	7	29	29	29	29	29	29
9						3	3	3	3	19	19	19	9	9	9	9	16	16	16	16	16	16	16	16	7	7	7	7	7	7	7	31	31	31	31	31	31
½							10	3	3	19	19	2	2	2	2	2	16	16	16	16	16	15	15	16	6	6	6	6	6	6	6	31	31	31	31	31	31
10								19	19	19	19	2	2	2	2	2	16	16	16	16	16	16	16	16	6	6	6	6	6	6	6	31	31	31	31	31	31
½									19	19	19	2	2	2	2	2	16	16	16	16	15	16	16	16	6	6	6	6	6	6	6	31	31	31	31	31	31
11												2	2	2	2	2	22	22	22	32	31	32	32	32	6	6	6	6	6	6	6	31	31	31	31	31	31
½												2	2	2	2	2	22	22	28	32	32	32	32	32	6	6	6	6	6	6	6						
12												2	2	2	2	2	22	22	22	22	22	22	22	22	28	28	28	28	28	28	28						
½																26	26	26	22	22	22	22	22	22	28	28	28	28	28	28	28						
13																26	26	26	22	22	22	22	22	22	28	28	28	28	28	28	28						
½																26	26	26	22	22	22	22	22	22	28	28	28	28	28	28	28						
14																26	26	26	22	22	22	22	22	22	1	1	1	1	1	1	1	27	27	27	27	27	27
½																								1	1	1	1	1	1	1	1	27	27	27	27	27	27
15																								1	1	1	1	1	1	1	1	27	27	27	27	27	27
½																								1	1	1	1	1	1	1	1	27	27	27	27	27	27
16																								1	1	1	1	1	1	1	1	27	27	27	27	27	27
½																								1	1	1	1	1	1	1	1	27	27	27	27	27	27
17																								1	1	1	1	1	1	1	1	27	27	27	27	27	27
½																								1	1	1	1	1	1	1	1	27	27	27	27	27	27
18																								1	1	1	1	1	1	1	1	27	27	27	27	27	27
½																																					
19																																					
½																																					
20																																					

INSTRUCTIONS

1. LOCATE LENGTH OF CONTAINER AT TOP OF CHART.
2. LOCATE WIDTH OF CONTAINER ALONG SIDE OF CHART.
3. THE BOX AT THE INTERSECTION OF THE TWO DIMENTIONS CONTAINS A NUMBER WHICH REFERS TO A SPECIFIC PALLET PATTERN.
4. BY REFERRING TO THE PALLET PATTERN DIAGRAM WHICH CORRESPONDS TO THE NUMBER IN THE BOX, THE PATTERN FOR THE CONTAINER SIZE MAY BE DETERMINED

FIGURE J CHART FOR 32"X40" PALLET

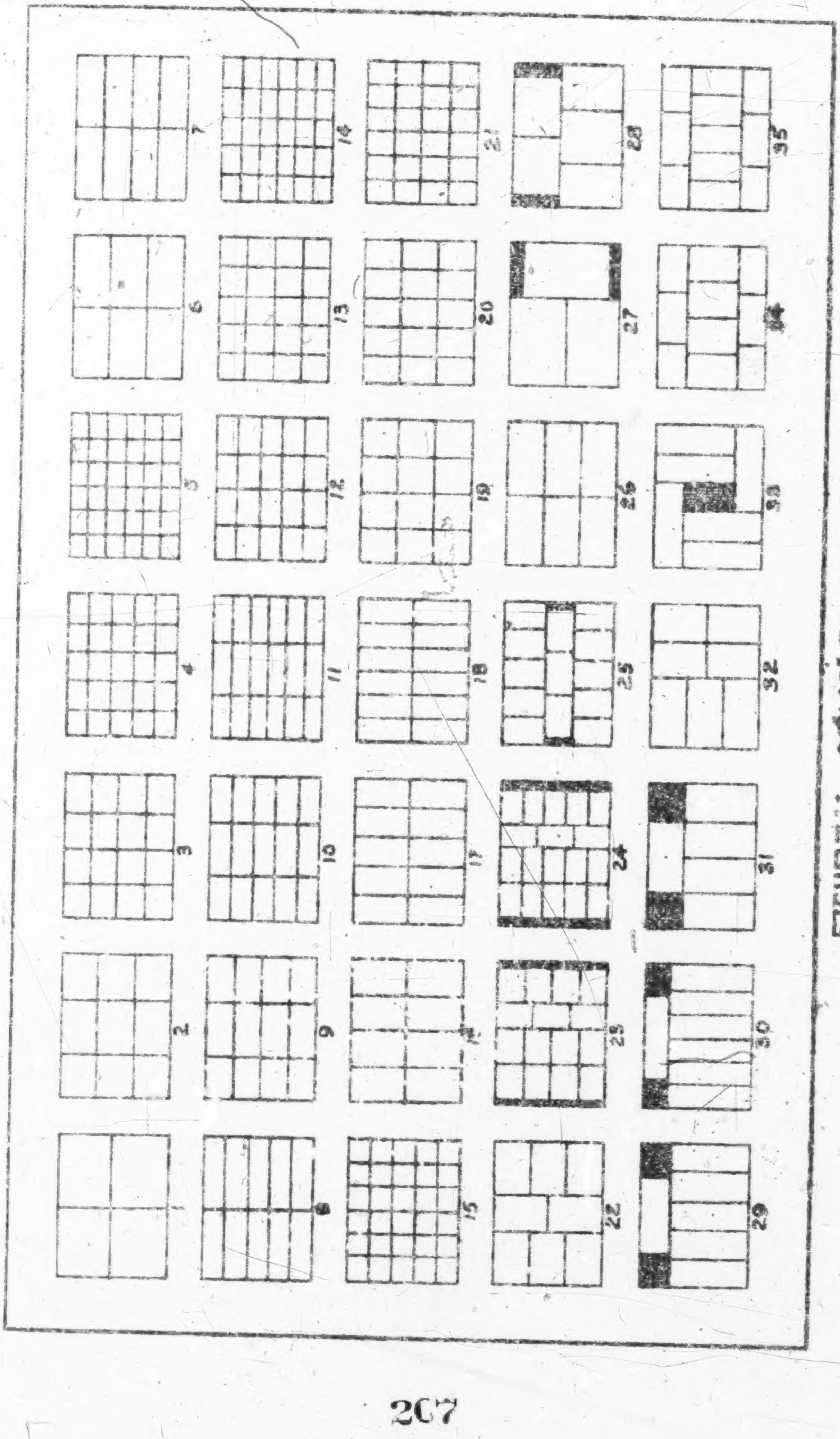

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35

FIGURE 1 32X40" PALLET PATTERN

PRE-PROCESSING

BIBLIOGRAPHY

Haynes, Oliphant. Materials Handling Equipment. Philadelphia: Chilton Company Publishers, 1957.

Materials Handling in Industry. New York: Anglo-American Council on Productivity, 1950

Warehouse Operations Handbook. Washington, D. C. General Services Administration, Federal Supply Service, U.S. Government Printing Office, 1953.

PROCESSING

OBJECTIVES

After studying this unit, the student should be able to develop an:

1. understanding of the basic production processes used in manufacturing and the factors involved in their selection.
2. awareness and understanding of primary processing, component processing, and assembly processing.
3. appreciation and understanding of the limitations involved in the selection of production processes.

INTRODUCTION

All of industry is concerned with production. Industries such as mining, fishing, lumbering, and manufacturing are all involved in production. The industry most concerned with production is manufacturing. Manufacturing consists of converting (changing) a raw material such as iron ore, oil, or leather into a usable product.

In the previous lesson you have learned that pre-processing involved materials that were received, handled, and stored before they are put together to form useful goods. In the next lesson we will take another step up the ladder of manufacturing knowledge. (Figure A.)

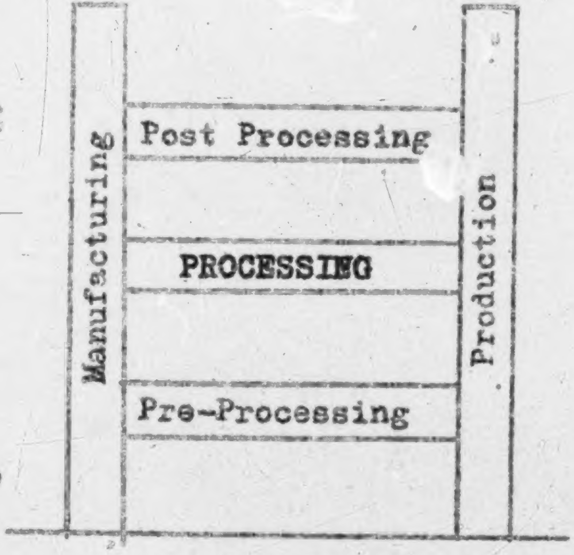


Figure A.

PROCESSING

This next step involves the methods employed when converting these pre-processed materials into usable goods. These methods are called processing. The number of processes available when converting materials are too numerous to mention in detail. Therefore, in this lesson we will be concerned only with the most common manufacturing processes.

PROCESSING

Manufacturing is concerned with converting materials into usable products. The method used when converting these materials into usable products is called processing.

Many factors influence the decisions as to the type of processes that will be used. Choice of the manufacturing process is dependent on the equipment available, the relationship between the quantity (number) to be produced and the cost of the production methods available. Another very important consideration before processes are selected is the materials available. One or more materials are required for any product and usually the same product can be made from a variety of materials. An example of this can be found in the automobile industry. Most automobiles are made of steel but some are made of fiberglass. Boats are made of wood, steel, aluminum, and plastics or a combination of these materials.

Other factors which affect the selection of a production process are strength, weight, elasticity, machinability, and availability of materials. Elasticity refers to that property in a material that has the ability to spring back after it has been depressed (pushed in). An example of this would be the coil spring on an automobile. You can depress the automobile spring by standing on its bumper, but when you get off, the car will return to its original position. Machinability is used to describe the relative ease with which any material may be machined.

Now that we have explored a few of the factors that influence the selection of manufacturing processes we will study some of these processes in greater detail.

Primary Processing - Primary processing involves breaking down a material into its component parts. Component can be defined as those parts that make up a raw material. The process of making steel is a good example of primary processing. (Fig. B - page 14:4). Iron ore, coke, and limestone are combined in a blast furnace. These ingredients are turned into "pig iron." Pig iron contains many impurities and a high percentage of carbon. High carbon content makes iron very brittle. To remove these impurities from the iron, it is processed in open hearth furnaces or bessemer converters. An explanation as to how these furnaces process materials will be covered in later lessons.

After steel is made, it is cast in molds called ingots. Ingots are then processed through rolling mills. Rolling

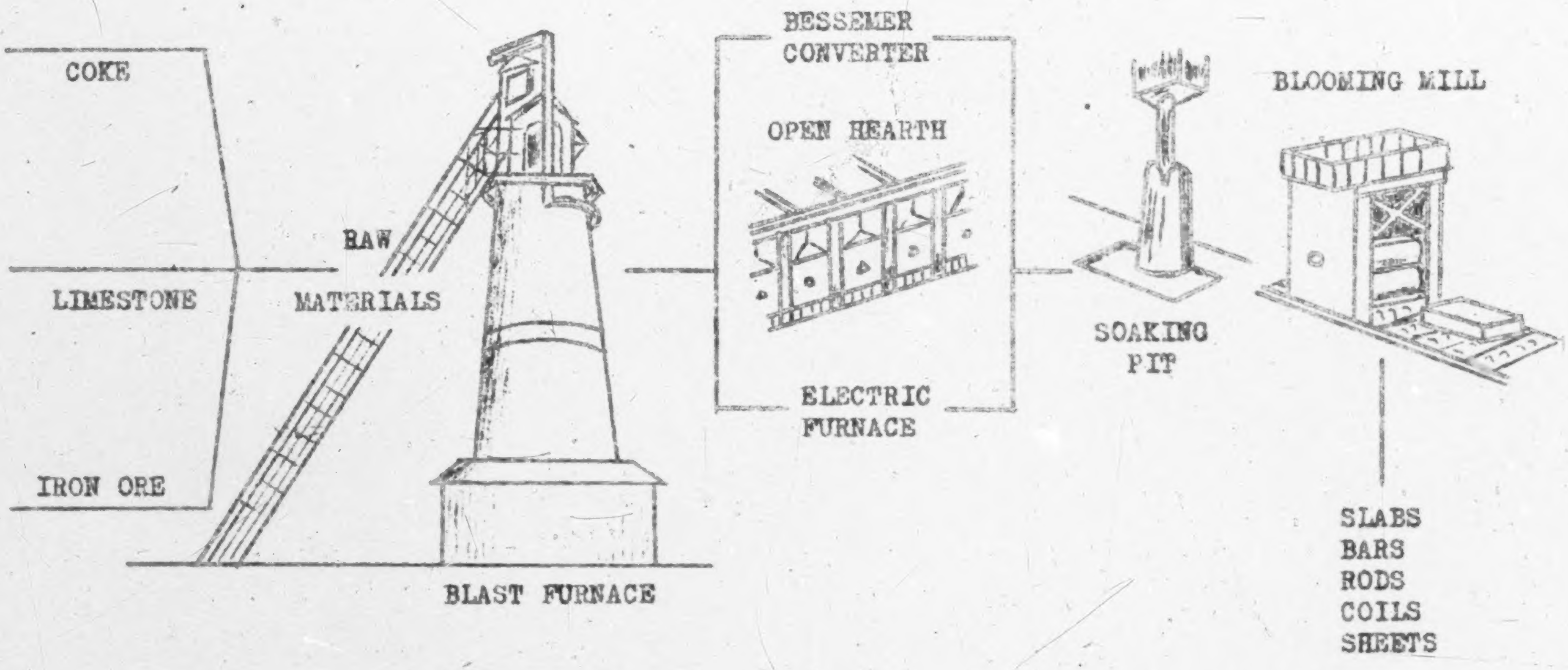

COKE
LIMESTONE
IRON ORE
RAW
MATERIALS
BLAST FURNACE
BESSEMER
CONVERTER
OPEN HEARTH
ELECTRIC
FURNACE
SOAKING
PIT
BLOOMING MILL
SLABS
BARS
RODS
COILS
SHEETS

FIGURE B. Primary processing of steel.

mills are motor-driven rollers through which the steel ingot is passed. The rolling mill can squeeze the steel into many different shapes. Beams, bars, railroad rails, and sheet steel are a few examples, Automobile manufacturers are one of the biggest users of sheet steel.

Component Processing - The primary processed materials such as sheets, bars, and coils of steel are purchased by a manufacturer. The automobile manufacturer, for example, then makes component parts that will be used in producing an automobile. Parts like fenders, hoods, wheels, frames, springs, and many other parts that make up the complete automobile. The process involved when making these parts is called component processing.

Assembly Processing - The method employed when assemblying basic parts into larger parts is called assembly processing.

After the component parts of an automobile are manufactured, they must be put together or assembled. When the numerous parts have been put together to form a finished automobile, the assembly process is complete. We now have a finished product that has gone through the various phases of processing.

SUMMARY

Manufacturing is the industry that is most concerned with production processes. This is because of the many processes that must be used when manufacturing a finished product.

The first or beginning steps which a raw material goes through to make it an industrial raw material is called primary processing. The next process is called component processing. This is when a material produced in primary processing is made into component parts. These component parts are then assembled into a finished product.

LABORATORY ACTIVITY

OBJECTIVES

The student will as a result of this activity be able to:

1. Recognize methods of processing by identifying pictures of various processes.
2. Analyze production processes and develop and select other methods which could be used.

INTRODUCTION

You have learned that it takes many processes to completely make an article. The different processes used are identified by the words primary processing, component processing, and assembly processing.

Primary processing is when a raw material is made into an industrial raw material that could be used in component processing. Component processing is when the industrial raw materials are used to make specific parts to be used in making a finished product. When these component parts are put together to make a finished product, the process is called assembly processing.

MATERIALS

Opaque projector, pictures of various operations used in primary, component, and assembly processing, and student problem cards.

ACTIVITY

You should be able to identify the three types of

LABORATORY ACTIVITY

processing. Pictures of three types of processing will be projected on the screen, one at a time.

Each of you has received three problem cards. When a process is projected on the screen, identify the process and answer the following:

1. Identify the process shown: ____________________
2. What limitations did the manufacturer have to consider before selecting this process: ________
   ____
   ____.
3. Name another way that this process could have been performed: ____________________________
   ____
   ____.

Analyze these problems carefully before writing your answers.

PRIMARY PROCESSING

OBJECTIVES

The student, after studying the unit "Primary Processing," should be able to demonstrate a basic understanding of:

1. Primary processing and its related terminology.
2. The relationship of primary processing and its subdivisions of manufacturing.

INTRODUCTION

In Processing you learned of one of the important elements common to all industries. Since processing is used in changing raw materials to useful products, it has changed all of our lives. Without these products our lives would be much different. We would live much as the cavemen did. Can you picture yourself wearing a tiger skin in place of the clothes you have on today? (Fig. A). It is easy to see that processing is a big subject. Almost everything in this room was processed. Think of all the different materials used. They must have been processed in many different ways. Certainly a piece of paper is bent differently than a piece of steel. Processing must truly be a broad subject. Much too broad to be covered in one unit. This unit on primary processing will help us to understand this vast subject.

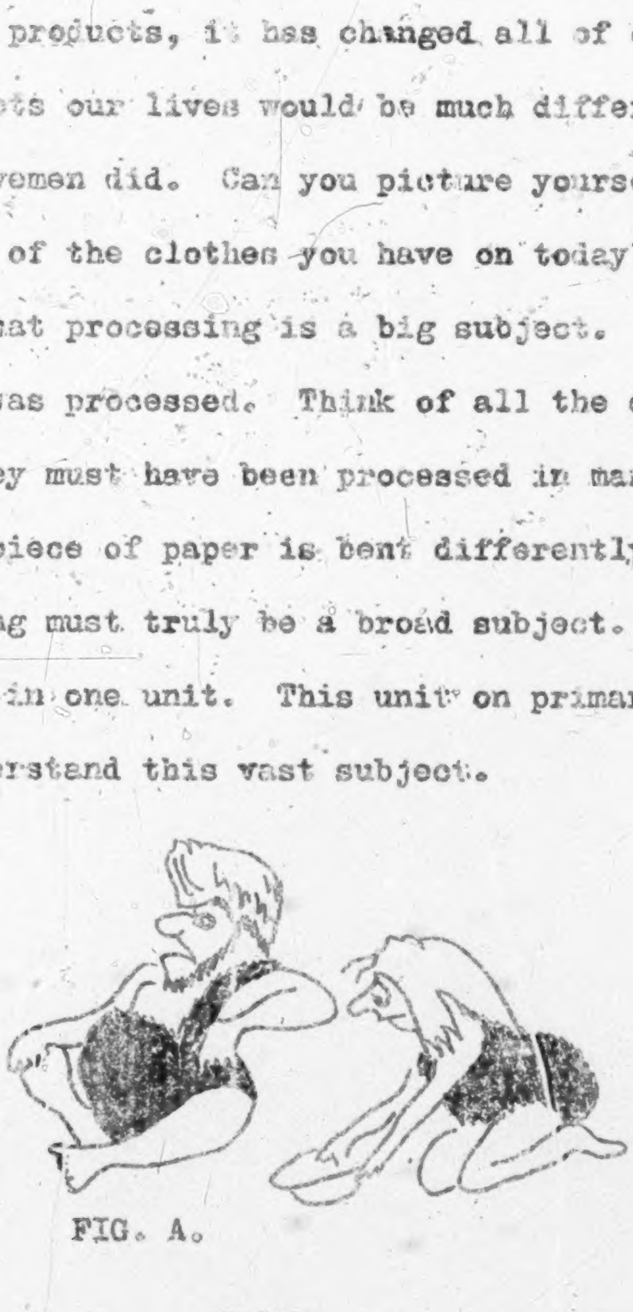


FIG. A.

PRIMARY PROCESSING

PRIMARY PROCESSING

Several years ago you entered school. Your parents may have said, "He is in primary school." Now that you have entered the junior high school you are in secondary school. Just as there are primary and secondary schools, there are also ways of doing primary or secondary processing. Primary schooling is your first years in school. Primary processing is the first step that a material goes through before becoming a product. Primary, then, means first or beginning. Primary processing is the making of a basic material (raw material) from which a product could be made.

When Henry Ford built his first automobile it was little more than a motorized horse cart. When he decided to build the Model T he needed steel. Steel is a basic material that is the result of primary processing. Later on, he decided windows were necessary in his automobiles. He made these windows out of glass. Glass, also is a result of primary processing. The automobile is the result of secondary processing.* The basic materials (glass, steel, rubber, and many others) that went into the making of the automobile are the result of primary processing. Today, the Ford Motor Company is engaged in primary and secondary processing. They make their own steel and glass as well as automobiles. There are three basic ways in which we do primary processing. They are 1) refining, 2) converting, and 3) bulk forming.

---

* Secondary processing is called "Component Processing" in these units. It is one of the units you will study later.

PRIMARY PROCESSING

Refining is a general term which covers many different ways of separating dirt and other undesirable elements from a substance or material. When Mom washes the clothes each Monday she is working as a one-woman refinery. How? Her washing machine is removing the dirt from the many soiled articles of clothing. Washing is one of the ways in which we do refining. Petroleum is one of the largest of the refining industries. This industry, from crude oil, refines gasoline, kerosine, oils, waxes, and greases. Also, the chemicals used in the manufacture of plastics and rocket fuel are the result of refining. (Fig. B, page 15:4). Other ways of refining include screening of gravel, ginning of cotton, and de-barking of trees.

Converting is a second general method of primary processing. It is the changing of a material by mechanical or chemical methods. The purpose of this changing process is to make the material more suitable for industrial processing. Tanning is one method of converting. This process changes tough animal hides into soft, workable leather. The leather is later manufactured into shoes, purses, and other items of value. Some other conversion processes with which you may be familiar are: The sizing of paper. The kneading of bread dough. The dyeing of cloth. The mixing of synthetic rubber.

Bulk forming is the third basic method by which we do primary processing. It refers to a gathering of a raw material in large quantities--these quantities are not in packages, boxes, or other containers. Bulk forming is best illustrated in the making of iron. Iron is made from iron ore. In the making of iron, coke and limestone

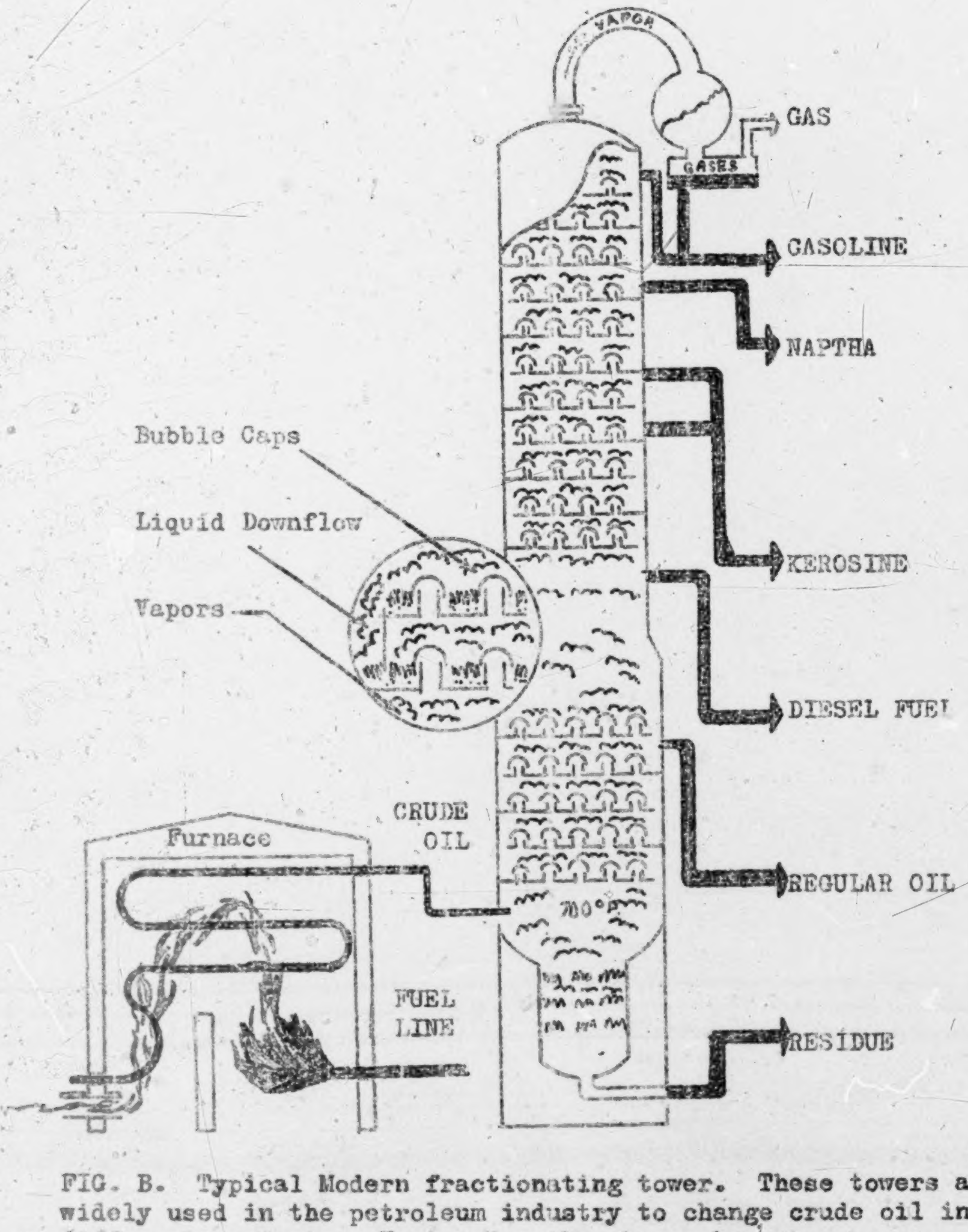

VAPOR
GAS
GASES
GASOLINE
NAPTHA
Bubble Caps
Liquid Downflow
Vapors
KEROSINE
DIESEL FUEL
CRUDE OIL
Furnace
REGULAR OIL
700°F
FUEL LINE
RESIDUE

FIG. B. Typical Modern fractionating tower. These towers are widely used in the petroleum industry to change crude oil into many different products. Heat makes the change happen.

are added to iron ore in giant furnaces which melt them together. When this mixture is poured from the furnace it is actually molten pig iron. The hot pig iron is poured into molds where it cools until it becomes solid. (Fig. C). These "pigs" are then dumped in large piles until they are needed for further processing. Pig iron, then, is an example of a bulk formed material. Other methods of bulk forming are grinding and pressing. Corn is ground into flour. And, wood fibers are pressed into fiber board.

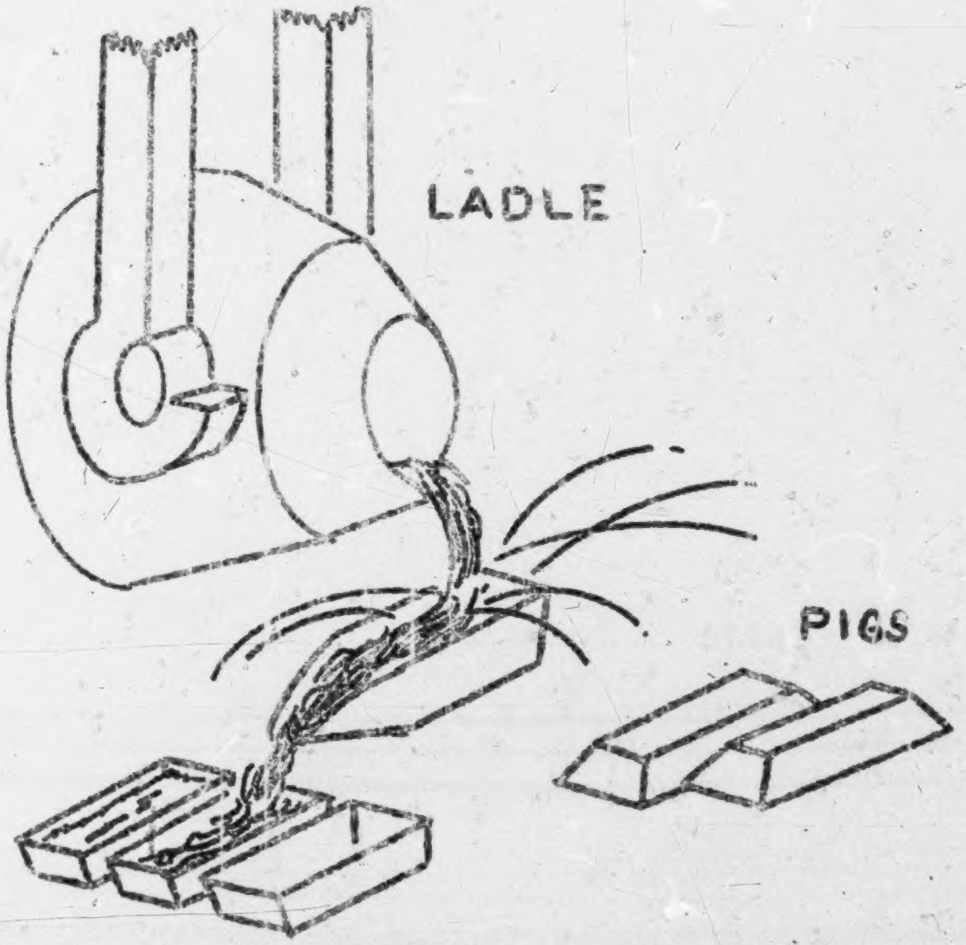


FIGURE C. Bulk forming of pig iron.

SUMMARY

All industries engaged in any sort of manufacturing must have processing. Primary processing is the first or beginning stages which a material goes through in order to make it into an industrial raw material. Some industries do only primary processing. That is, some industries manufacture raw materials as a business. We do primary processing by three basic methods. These methods are refining (a separating process), converting (a changing process), and bulk forming (a gathering process). In the making of an industrial raw material it is not uncommon for the material to go through all three basic methods of primary processing.

LABORATORY ACTIVITY

Objectives

The student, after participating in the primary processing activity, will understand the :

1. Converting process of mixing.
2. Converting process of cooking.
3. Refining process of filtering.
4. Bulk forming process of cooling causing a solid to form.

Introduction

Sugar is so important to man that it has been called the foundation of life. The average person in the United states will use ninety-five pounds of sugar per year. Most of the sugar we use comes from sugar cane or sugar beets. Other sources of sugar, however, include the maple tree, grapes, milk, and corn. Corn sugar is widely used in the making of candy. Next time you buy a candy bar, check the wrapper for the type of sugar used. When sugar has been bulk formed it is usually transported in large trucks or railroad cars.

Materials (Per four person group.)

1 small package of corn starch
1 beaker of hydrochloric acid diluted with water (Teacher prepared -- 10 parts water to one part hydrochloric acid.)

Equipment

1 hotplate
1 cloth filter
1 heavy rubber band
2 metal spoons
2 pairs of rubber gloves
2 empty pyrex glass containers (med. size)

Activity --Primary processing of corn sugar.

Two students should be engaged in the activity at one time. The other two students should check the steps and answer the written questions. Students may wish to switch roles at the halfway point.

1. Empty the contents of the corn starch package into the empty glass container.

2. Slowly, add the beaker of hydrochloric acid and water to the corn starch. (Wash any acid from the skin with water).

3. Mix the corn starch, acid and water together stirring with a spoon.

4. What kind of activity is mixing? ______________________.

5. Place the mixture on the hot plate, and turn the hot plate to "high."

6. Continue stirring the mixture until it begins to boil.

7. Allow the mixture to come to a boil. When boiling begins, reduce the heat so that the mixture boils slowly.

8. Continue stirring to prevent the mixture from sticking to the sides and bottom of the container.

9. Fix the cloth filter over the other empty container and secure it firmly with the large rubber band. (Fig. D).

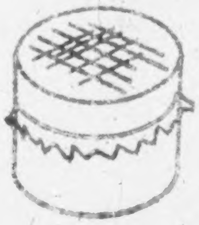


FIG. D. Strainer.

10. As the mixture begins to thicken, pour the hot liquid through the filter and into the second empty container. (Fig. E).

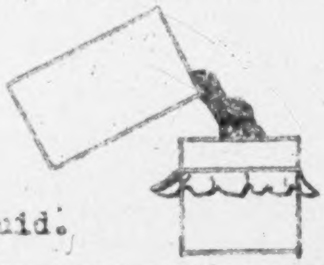


FIG. E. Pouring the liquid.

11. What kind of a primary processing activity would straining be? ______________________________.

12. Remove the cloth strainer. Return the strained liquid to the hot plate and continue with a slow boil.

13. The slow boiling of the liquid causes evaporation of the water thus causing the liquid to thicken. What kind of basic primary processing would evaporation be? ________________.

14. Continue stirring. Stirring helps the evaporation of the water to take place faster and prevents the mixture from sticking to the container sides and bottom.

15. When the liquid has turned to a good thick syrup, remove it from the hot plate and allow it to cool and become solid.

16. In cooling and turning to a solid what basic process is taking place in this product? ____________________.

17. What other industrial raw material which you have read about is allowed to form in this manner?____________________.

18. Describe the industrial raw material you have made.

19. How can we justify saying that this product that we have made is an industrial raw material?

20. Clean up your mess and materials. Leave the hot plate out to cool. Turn this paper into the teacher with all four names of the group on the front page.

BIBLIOGRAPHY

CORN STARCH, Corn Industries Research Foundation, Inc. Washington, D.C. 1964.

REFINING

OBJECTIVES

The student, after study and completion of this unit, will be able to:

1. Describe some of the common refining processes.
2. Understand that refining is a basic primary process important to manufacturing.

INTRODUCTION

The most familiar part of manufacturing to most of us is production. We know that production is concerned with making something. The making of something means to do certain things to it. In other words, to make an airplane we have to carry out certain activities. All of these different activities are called processing.

A process is a particular way of doing something. When you got ready for school today, you went through the processes of washing, dressing and eating breakfast. An activity or a group of activities that result in a change is processing.

Some of the processing having to do with production is called primary processing. Primary processing is the activity concerned with the product near the beginning of the overall manufacturing process.

The primary process that will be explained in this unit is refining. Anyone who has played in a sand box or at the beach has probably sifted the sand. Sifting the sand is a type of refining.

REFINING

Most of us tend to link refining to two common products - oil and sugar. Oil refineries and sugar refineries are not the only industries that refine material.

To refine means to remove impurities from a crude or impure material. Refining does not mean to purify completely in all cases. Even if we improve the quality only a little we have refined.

There are many methods of refining. Refining includes (1) crushing, (2) washing, (3) filtering, (4) evaporating, (5) centrifuging and (6) distilling.

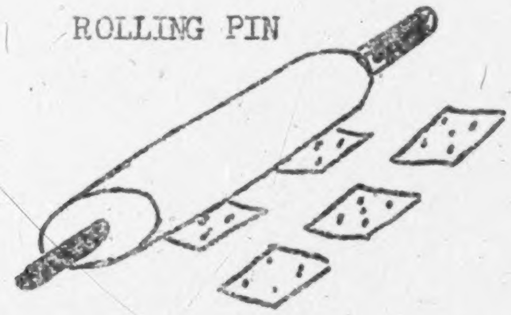


Fig. A Crushing: Rolling pin crushing crackers into cracker meal.

Crushing is the refining process concerned with size of parts. The material is reduced to a smaller size by pounding or smashing the larger particles to smaller ones. The use to which the material is put would determine how small the particles are to be. (Fig. A).

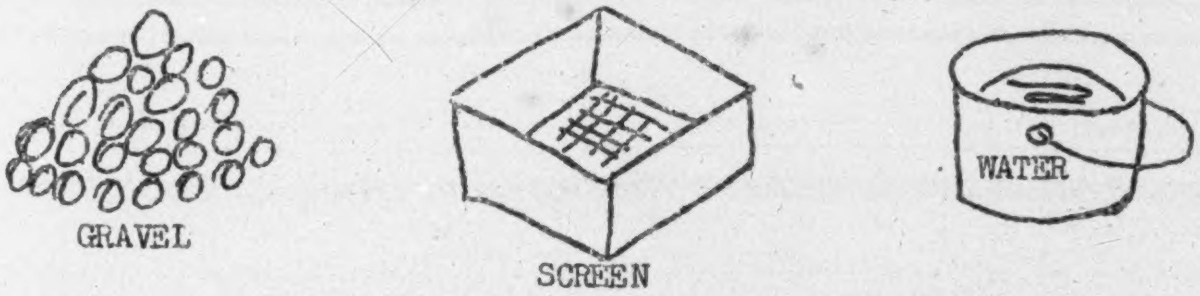


Fig. B Washing: Gravel is placed on the screen and water poured over it.

Washing is a refining process that cleans the material of unwanted impurities. This is probably the simplest of refining processes and in a number of cases water is used for washing. (Fig. B).

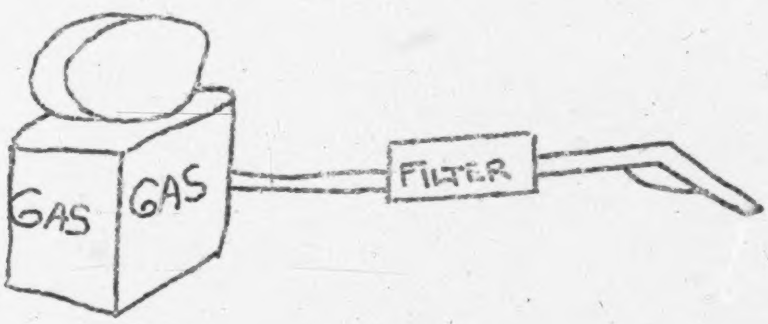


Fig. C Filtering Gasoline

Filtering is the refining process that removes solid impurities from liquid material. Liquid material is passed through a screen or a mesh to remove impurities. In some cases the filter is a metal screen. In other cases the filter is a cloth. Sometimes paper is used as a filter material. (Fig. C).

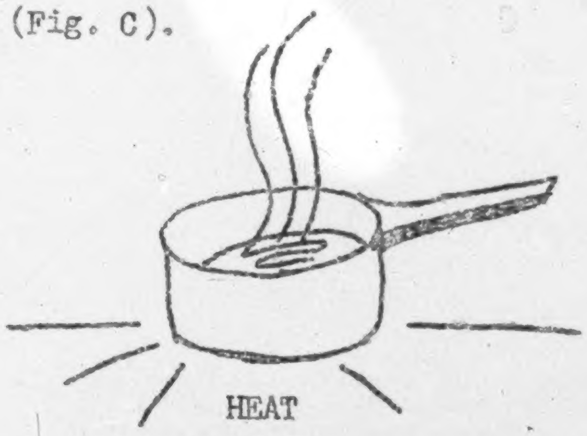


Fig. D Evaporating: Water evaporates when heated.

Evaporating is the process of changing material from a liquid to a vapor. Evaporation can be speeded up by heating. Heat is applied to evaporate the unwanted liquid. The remaining material has been refined by evaporation. (Fig. D).

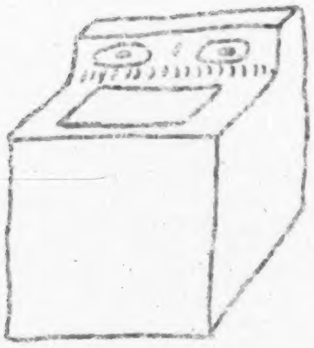


Fig. E Centrifuge: The automatic washer spins water from clothes.

Centrifuging is a refining process that uses centrifugal force to separate one material from another. When material is spun rapidly centrifugal force causes the heavier material to move away from the center. Some means is then used to remove one material from the outer edge of the machine. The remaining material is taken from the center of the machine. (Fig. E).

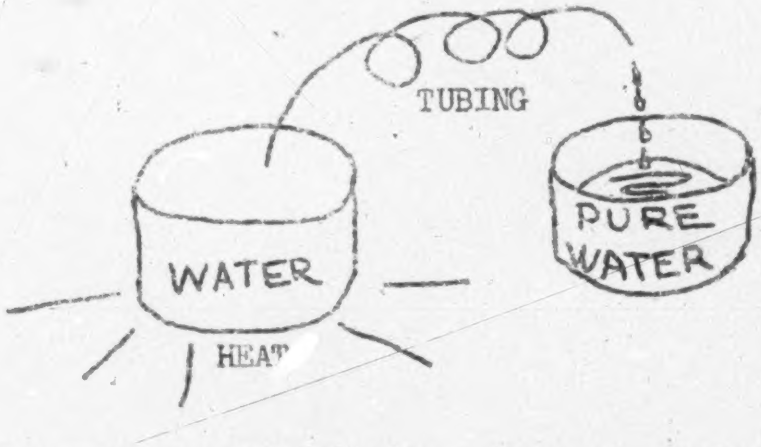


Fig. F Water Distillation: Water is heated to a vapor, then cooled to a liquid.

Distillation is the process that occurs when a liquid is vaporized and then is changed back to a liquid. A number of common products are mainly the result of refining by distillation. Two of these are oil and pure water.

Water can be distilled very simply. It can be heated to vaporize. The vapor is moved to some other container and cooled. Cooling water vapor causes it to become liquid. The liquid is pure water. Note that the process of distillation is really two processes. The first is evaporation. The second is condensation which is evaporation in reverse. (Fig. F).

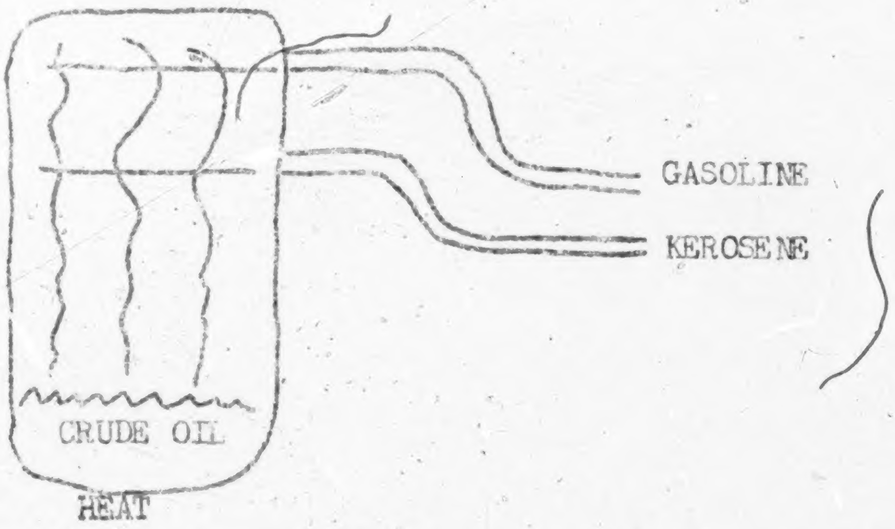


Fig. G Oil Distillation: Oil is heated to a vapor, then cooled to a liquid.

Oil is a material that is refined by distillation. The crude oil is heated to a certain temperature. When this temperature is reached, the oil vaporizes. As the vapor rises up through the container it passes through collector plates. The lightest vapor collects on the highest plates. This cooled vapor is taken to separate containers to be further cooled. Gasoline would go to one container. Kerosene would go to another container. Gasoline and kerosene are only two of the many products refined from crude oil. (Fig. G).

Most of the products already mentioned have been in the liquid state. Refining processes are also applied to solid materials. These processes include milling (grinding to small particles), crushing (reducing to small particles) and screening (type of filtering).

Some food material is refined by milling. Coffee beans must be milled (ground) before they can be used to prepare the coffee drink. Many stores have coffee mills so customers can grind their coffee fresh as they buy it.

Crushing, screening and washing are processes used to refine solid materials. Coal is refined by these three processes. The coal is crushed to reduce its size. It is screened to separate different size lumps. It is washed to remove impurities.

Sugar is a material most associated with refining. A brief description of sugar refining will illustrate the variety of processes which are carried out to complete the refining of sugar.

A raw material for sugar is sugar cane. The cane must be crushed and washed to separate the juice from the cane. The juice is filtered to remove cane particles. The filtering is done by passing the juice through a material that has tiny holes. The cane particles cannot get through these holes.

The filtered cane juice is evaporated. The juice is placed in shallow pans and heated. Evaporation separates water from the cane juice. The remaining material is part syrup and part sugar crystals.

The syrup and sugar crystals are separated by centrifuging. When the syrup and crystal mixture is spun rapidly, the heavier syrup moves outward. The crystals remain near the center of the spinning container. The crystals are removed from one place on the centrifuge. The heavier syrup is removed from another point.

The crystals taken from the centrifuge are further refined. These crystals must be filtered before they are finally granulated.

SUMMARY

Refining is not a single process. In the case of sugar, many refining processes are carried on. These include crushing, washing filtering, evaporating. Each of these processes helps to improve the quality or purity of the sugar.

Other products are refined by other processes. Oil refining is mainly a distilling process. Purifying water is also done by distilling.

Solid materials can also be refined. Refining terms that apply to solid material are milling, crushing, screening and washing.

The important point to remember about refining is that it is primary processing. It is a process that is carried out on a great number of materials to make them purer products.

LABORATORY ACTIVITY

Objective

The student, through participation in this laboratory activity, will experience selected refining processes.

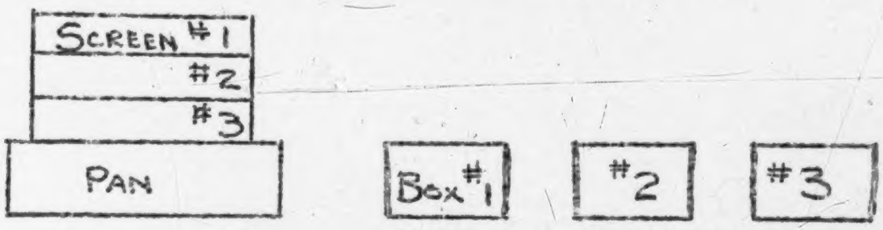
1. Screening a material to a given size.
2. Washing a material to make it clean.

Materials and Equipment

1. Screens (constructed) with three different mesh or opening sizes.
2. Plastic pan or container to catch water.
3. Amount of unwashed gravel.
4. Water.
5. Containers for washed and screened gravel.

Procedure

The refining process to be carried out is that of screening and washing. The screens are frames upon which are fastened wire mesh of three different sizes. The screens are stacked over the pan, largest mesh on top, smallest on the bottom.



A quantity of mixed unwashed gravel is placed in the top screen. Water is poured over the gravel until the dirt is washed down into the pan. The screens are tapped (use mallet or hammer). Tapping should cause the gravel to travel through the screens and be sorted by size.

The gravel is dumped from each screen into the three containers. Number one screen is dumped into number one container.

Results

The student is involved in the simple refining processes of screening and washing. He can see how solid materials can be cleaned and sorted to certain sizes. This should help him understand that refining is a broad term that can be applied to any process that improves quality, removes impurities or upgrades materials.

CONVERTING

OBJECTIVES

After studying this unit, the student should be able to:

1. Differentiate between converting, refining and bulk forming.
2. Understand the meaning of converting and its sub-elements.
3. Understand the sub-elements of converting.

INTRODUCTION

Materials of manufacturing are changed in a number of ways. These changes are necessary for making things more useful to us. For example, cotton cloth is more useful to us than raw cotton.

There are three primary processes in manufacturing that bring about material changes. These are refining, converting, and bulk forming. Refining is the separating of a material into a more pure form. Converting is a mechanical or chemical change made in the material itself. Bulk forming is a change in the shape of the material. These processes do not usually result in a completely manufactured product. They are only steps to make additional manufacturing possible.

To present the relationship of the refining, converting and bulk forming processes, cotton cloth will be used as an example. After cotton is picked, it is put into a machine called a gin to remove fibers from seeds. (Ginning is refining.) It is then spun into yarn.(Spinning is bulk forming.) Next, it is bleached and dyed. (Dying is converting.) Notice these are just steps in the manufacturing of cloth.

The converting processes include: bleaching, dying, tanning, digesting, compounding, sizing, baking and roasting, and grinding. Of course these are not all of the converting processes. However, by studying these examples we will better understand the material changes which take place.

CONVERTING

Bleaching is the removal of color. This is usually done by a chemical process. Bleaching is a converting process used in more manufacturing than most people realize. Shellac, a wood finish, goes through a bleaching process during its manufacture. The paper industry also uses a bleaching process. Without it you wouldn't have the nice white paper you now take for granted.

To the textile industry, bleaching is a very important part of the manufacturing process. No fabrics made from natural fibers would be pure white if they were not bleached. Your mother bleaches white clothes to keep them white. (Fig. A)

FIG. A. Bleaching: The removal of color makes the product white.

Bleaching is also important in the processing of fabrics to be dyed. If all of the natural color is not removed, the dye will not color evenly.

In some cases the bleaching process is done before the thread is woven into cloth. A tweed fabric, for instance, must have the threads bleached and dyed before it is woven. In other cases the weaving is done first then the fabric is bleached.

Dying is the addition of color. Until 1856 all dyes were from natural sources. William Perkins is credited with the discovery of the coal tar (a thick black liquid obtained from coal) process of making chemical dyes.

A dye must be able to impart color and to attach itself to a fiber. In other words it must become a part of the object it contacts. Paint is not a dye. It covers and clings to an object but it is not absorbed by it.

Many industries use the converting process of dying. Among them are the paper and textile industries. The plastic and ceramic industries often use a dying process. In fact it is difficult to think of many industries that don't use dye in the manufacture of some of their products. (Fig. B)

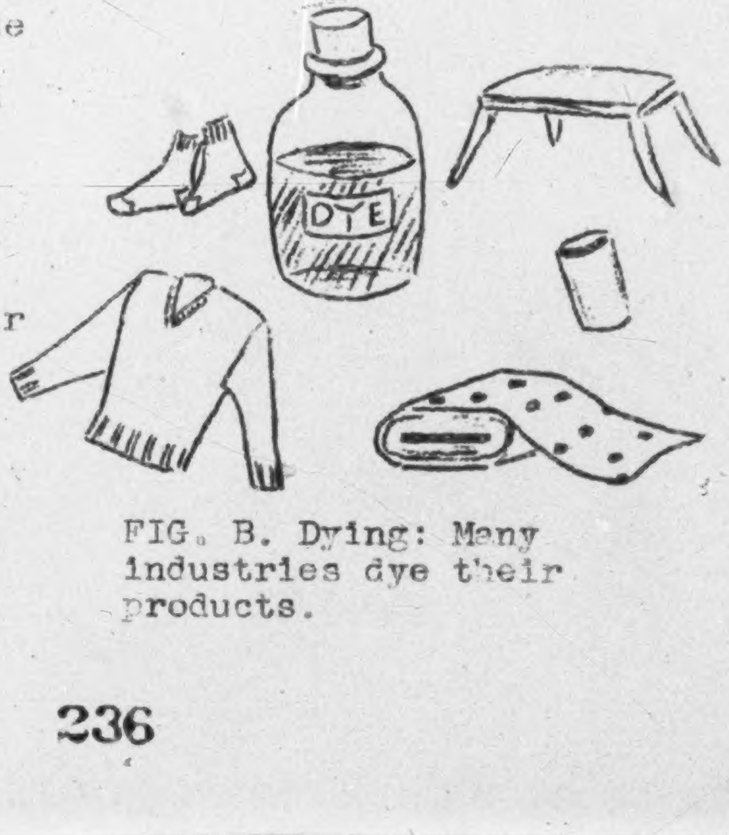


FIG. B. Dying: Many industries dye their products.

Even some woods are dyed. The dye is mixed with other ingredients so that it can be absorbed by the wood. This kind of dye is called a stain.

Almost anyplace you happen to be you can see something that has been dyed during its manufacture. We would live in a rather drab world were it not for the invention of chemical dyes.

Tanning is a converting process used in the manufacture of leather. Leather is made from animal pelts. Tanning changes the pelt into a soft pliable material which will not decompose.

Tanning is limited to leather making. The leather making industry is a large and important industry and perhaps the oldest. We know that ancient people used animal skins for clothing. In fact they probably found many uses for them. Just when tanning was discovered to preserve the skins is unknown.

Tanning is so called because it uses tannic acid. Tannic acid comes primarily from trees. Some of the common trees that contain tannic acid are hickory, hemlock, and sumac. The pelts are soaked in a liquid made from the bark of these trees. The strength of the solution and the length of time needed depends on the pelt. Thick pelts take longer to tan than thin pelts.

The tannic acid reacts chemically on the pelt. When a pelt is properly and thoroughly tanned it is called leather. It must then be finished with oil or dye.

Most of the leather in the United States is used for shoes and boots. But many other things are also made of leather such as gloves, jackets, saddles and upholstery material. (Fig. C)

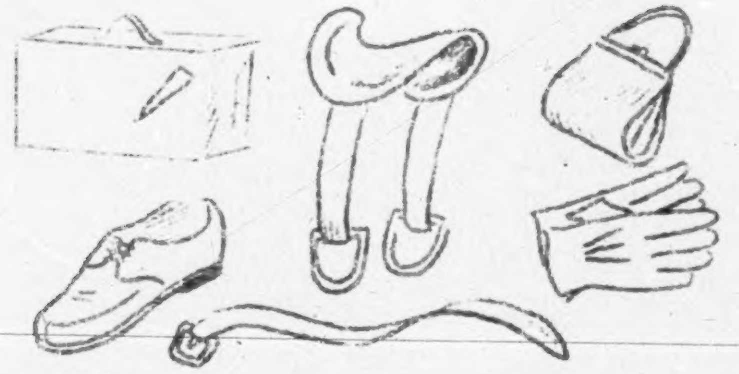


FIG. C. Tanning: The leather industry tans its products.

Digesting is a converting process. We are referring, of course, to a specific type of digesting. This process uses heat and moisture or chemicals to soften or dissolve.

The food industry uses this often. Most of the canned foods we buy have been through this converting process. A few of them are: sweet potatoes, beans, carrots and peas. Pumpkin is another good example. In its raw state it is hard and crisp. Before it can be made into pumpkin pie it must be softened by heat and moisture. (Fig. D)

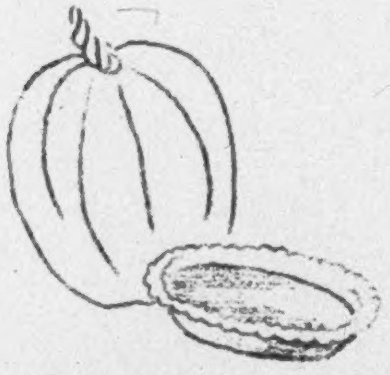


FIG. D. Digesting: Converting the hard pumpkin, bu heat and moisture into soft pie.

The paper making industry uses this process to make wood pulp. In fact during this process they use a large cooker called a digester. Into this digester are put wood chips and chemicals. This is cooked at a uniform temperature until the chips are reduced to cellulose fibers. The fibers are then blown out of the digester into a bin called a "blow pit". These fibers are called wood pulp. It is from this wood pulp that the paper is formed. (Fig. E)

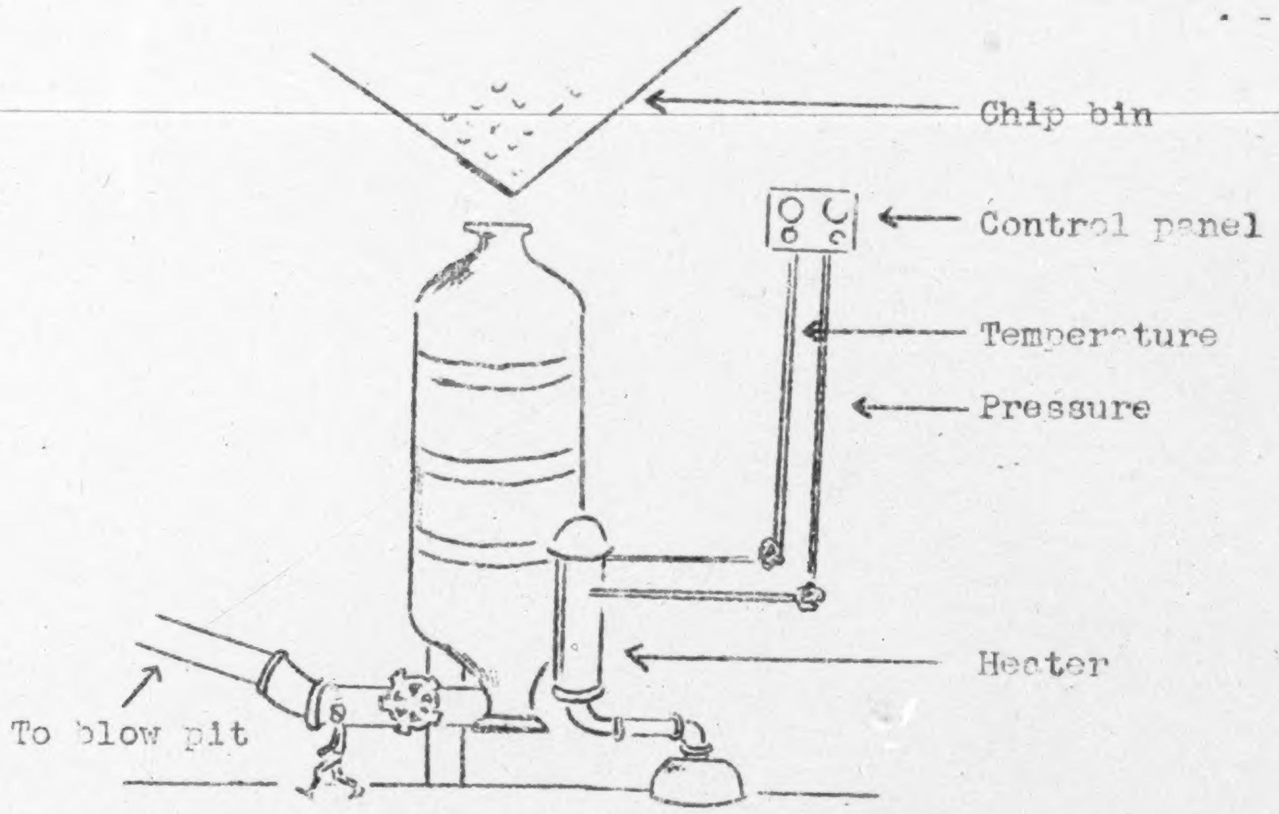


FIG. E. Digesting: Digester used in making wood pulp.

The converting process of digesting is used in many other industries. Glue is made by digesting. It comes from the hides and bones of animals. After the bones or the hides are clean and free of grease and oil they are cooked with water. This extracts a jelly-like substance called collagen. The water and collagen are then drawn off. The water is evaporated and the collagen is allowed to dry. It is then either flaked or ground.

Compounding is the combining of two or more elements in fixed proportions. A compound is different than a mixture. A compound must have characteristics different from the elements that go into it.

Glass is a very good example of compounding. You are all familiar with the characteristics of plain window glass. It is transparent, fragile and smooth. It is made, however, of sand, limestone and soda ash. None of these ingredients have the same characteristics as glass. However, when they are compounded under the proper conditions they form into glass.

In glass making, sand, limestone, and soda-ash are mixed together in the right proportions. This mixture is called a "batch". It is put into a large brick lined furnace whose internal temperature goes as high as 2700 degrees Fahrenheit. (Fig. F) When it is drawn out of the furnace it

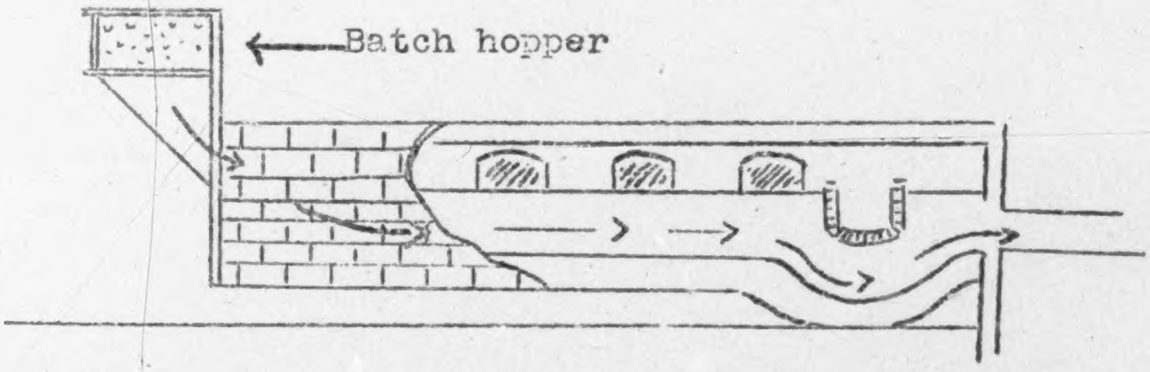


FIG. F. Compounding: Sand, limestone and soda-ash melted at high heat in a furnace form glass .

is formed while still hot. Sometimes other things are added to the "batch" before it goes into the furnace. This is done to make different kinds of glass such as colored glass. But they all rely on compounding sand, limestone and soda-ash for the basic content.

Many things are compounded during their manufacturing process. A few of them are baked goods, soap, cosmetics and paint.

Sizing is a process of filling porous materials. Paper goes through a sizing process to make it smooth. Fabric is also sized to give it body. Laundry starch is an example of this type of sizing. (Fig. G)

FIG. G. Sizing: Starch is a form of sizing used in shirt collars.

Baking is the converting process of drying and hardening by dry heat.

You all know that the baking industry uses this converting process. Did you know that bricks too are baked? This converts them from soft clay into hard bricks. They are baked in large ovens called kilns at very high temperatures.

Portland cement is a good example of this converting process. After the ingredients which go into portland cement are ground they are baked. A rotating kiln is used. As the kiln revolves, the material gradually slides downward and is exposed to more and more heat. The heat drives all moisture, carbon dioxide and other gases from the mixture. When it emerges from the kiln it is in the form of hard clinkers.

These clinkers are harder than the original rock included in the mixture. These clinkers must then go through further processing. (Fig. H)

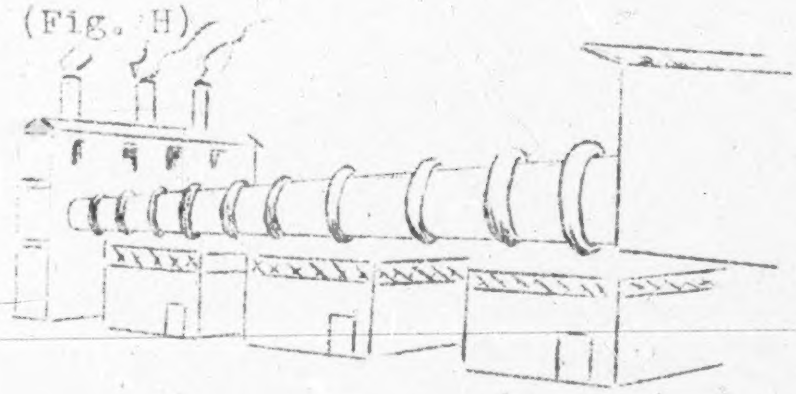


FIG. H. Baking: Cement is baked in a rotating kiln.

Grinding is the process of crushing material into fine particles between two hard surfaces.

This process is used in making portland cement. The raw materials (usually limestone and clay) are crushed and pulverized. During the fine grinding stage the crushed raw materials are put into vats called tube mills. These mills contain thousands of steel balls. When the tube mill revolves the steel balls are carried part of the way to the top. Then they fall and grind the material. (Fig. I)

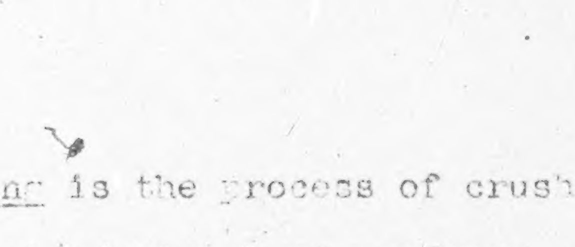


FIG. I. Grinding: Limestone and clay are ground in tube mills to make cement.

After this grinding, the material is put in a kiln for further processing which turns the material into very hard clinkers which must be ground again. In fact it goes through two more grinding operations. The finished product is finer than face powder.

Grinding is also used in other industries. The paint industry must grind pigments or colors. This is done in tube mills with steel balls much the same way that cement is made.

The drug industry uses the grinding process to make its powders and tablets.

SUMMARY

Converting is a change in the material itself. It is the step that makes further manufacturing possible. The major converting processes are bleaching, dying, tanning, digesting, compounding, sizing, baking and grinding.

Leather has be be *tanned* and *dyed* before it is made into shoes. Fabric has to be *bleached* and *dyed* before it is manufactured into clothing. Wood is often *stained* before it is manufactured into furniture. The shoes, the clothing and the furniture are all end results. Converting helps bring about these results in the manufacturing process.

LABORATORY OBJECTIVE

The student, after participating in laboratory activities, should reinforce his concept of converting as it relates to the manufacturing process.

LABORATORY ACTIVITIES SUGGESTED

1. Bleaching
    1.1 Cut unbleached muslin into small pieces (3"x5")
    1.2 Bleach in a small, wide mouth container
    1.3 Compare with unbleached material
2. Dying
    2.1 Dying bleached muslin
        2.11 Cut material into pieces (3"x5")
        2.12 Dye in small containers of several colors for showing variety.
    2.2 Staining
        2.21 Cut three blocks of softwood about (3"x6")
        2.22 Stain each of the three a different color to show how an inexpensive wood can be made to look like a more expensive one.

BULK FORMING

OBJECTIVES

The student, after studying this unit, should be able to:

1. Understand what bulk forming means.
2. Understand how bulk forming is related to refining and converting operations.
3. Describe basic ways bulk forming is done.
4. Describe the results of bulk forming and how it helps in further processing.
5. Identify examples of bulk-formed materials.

INTRODUCTION

Some materials used in manufacturing come from living things (plants and animals). Other materials are taken directly from the earth, air, or water. Both kinds of materials are called natural materials.

Most of the materials we use are not natural. They have been changed before we use them. The first step of this change is primary processing. Primary processing of natural materials begins with refining and converting operations. Bulk forming is the final operation of primary processing.

BULK FORMING

Bulk means a large amount or large mass of material. This large mass is a larger amount of material than can be used at one time. Another name for bulk might be supply or stock.

An example of bulk material is gasoline. A bulk of gasoline is made at an oil refinery. Not all of the gasoline can be used at once. Most of the gasoline is stored in bulk tanks. Bulk trucks move the gasoline from the bulk tanks to a service station. Automobiles use small amounts of gasoline at a time from the bulk at the service station (Fig. A).

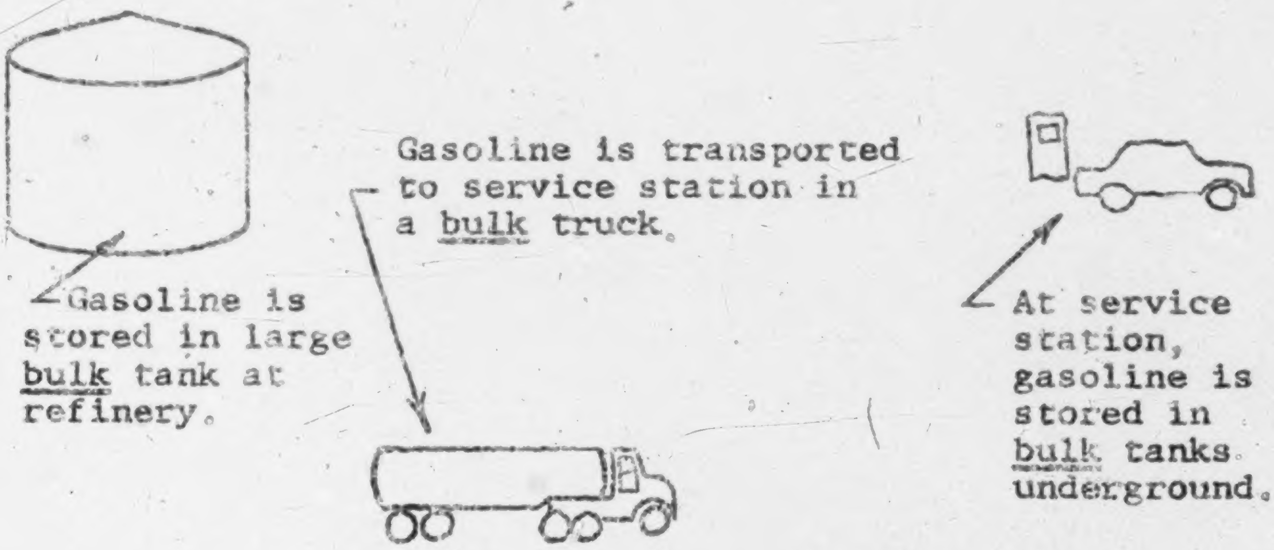

Gasoline is stored in large bulk tank at refinery.
Gasoline is transported to service station in a bulk truck.
At service station, gasoline is stored in bulk tanks underground.

FIG. A. BULK GASOLINE

Bulk forming means changing the size, shape, or form of the bulk materials produced by refining and converting operations. Bulk forming must be done because the refined and converted materials cannot be used in the form they are in. Bulk-formed materials are never finished articles. They become the raw materials (supplies) for other manufacturers.

Iron is a good example of a material that is bulk formed for use by other manufacturers. It is produced by refining and converting iron ore in a blast furnace.

The heat used to refine the ore changes the iron into a liquid. Unless the hot iron can be used before it cools, it must be bulk formed.

The liquid iron is bulk formed by allowing it to run into a mold. Cooling changes the form of the iron from a liquid to a solid. When the iron is solid, it has the size and shape of the mold. This kind of bulk-formed iron is called pig iron. Pig iron cannot be used to make anything until it is processed again (Fig. B).

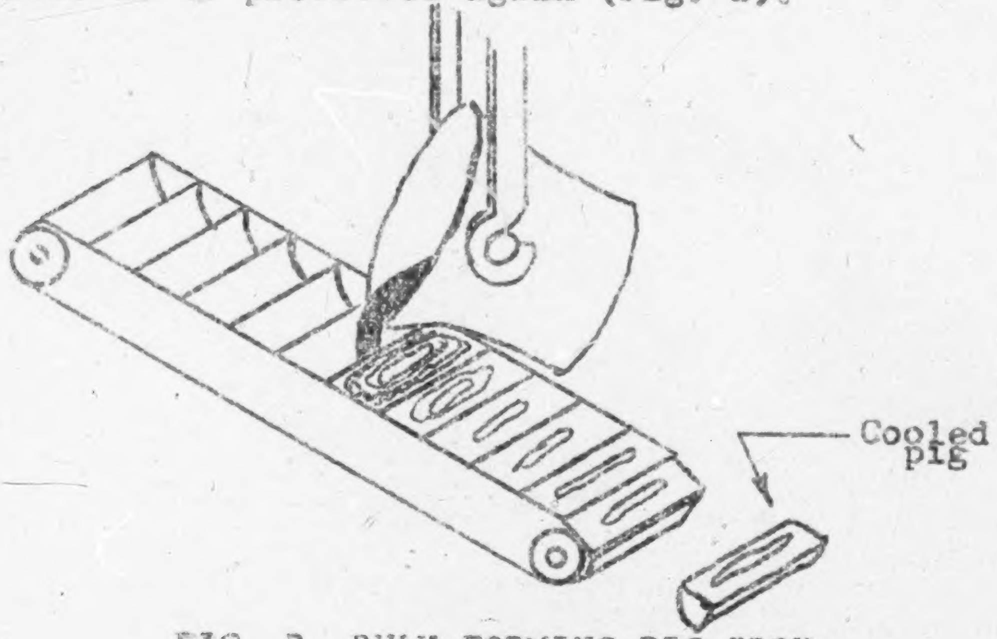


FIG. B BULK FORMING PIG IRON

Pig iron becomes a raw material for many manufacturers. One company might use the pig iron to make parts (components) for tractors. Another company might use the pig iron to make parts for cars.

Sometimes bulk-formed materials become the raw materials for further primary processing. Pig iron can be changed into steel by further refining and converting. After steel is made, it must be bulk formed again (Fig. C).

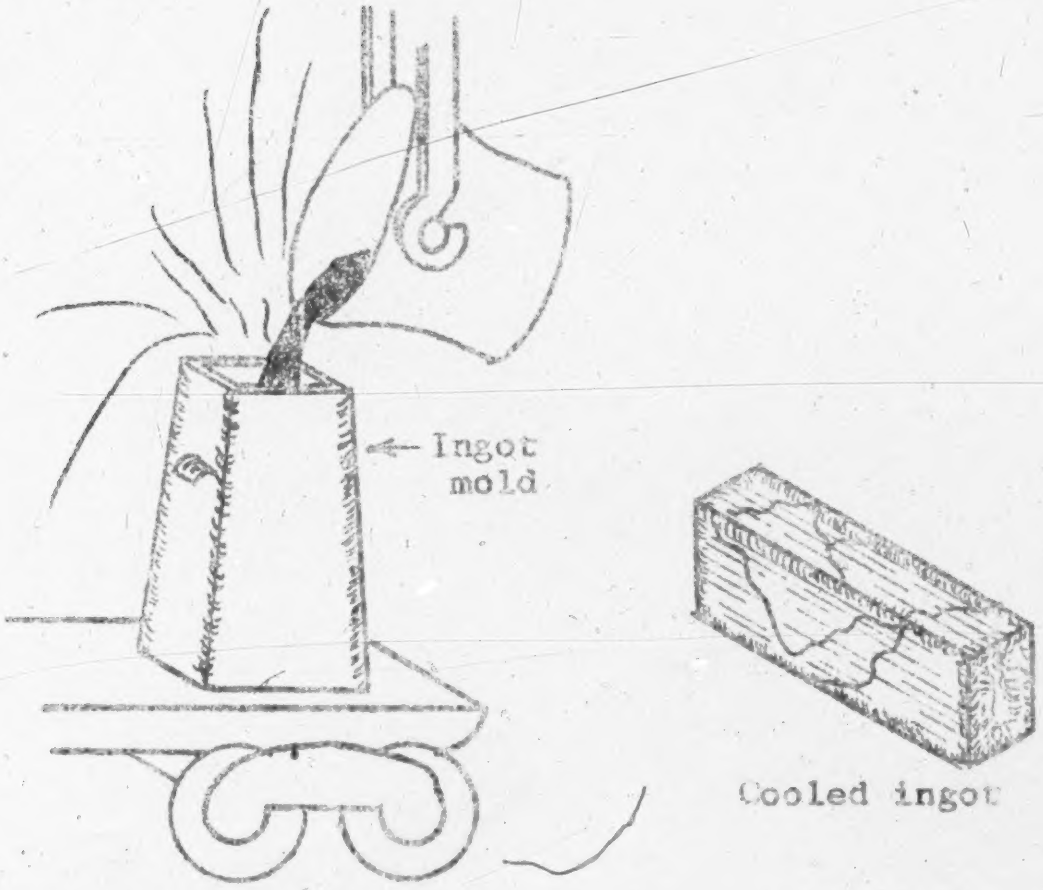


FIG. C BULK FORMING STEEL

BULK FORMING OPERATIONS

There are over thirty different bulk forming operations. All of these operations can be grouped into four classes. Many bulk forming operations are done mechanically. Some operations depend upon a change in the amount of heat. Other materials are bulk formed by allowing chemicals to act on them. A few materials are bulk formed by adding new materials to the bulk.

BULK FORMING MECHANICALLY

Mechanical forming is done by machines. Machines can bulk form materials by breaking apart or pushing together.

Cement (used in concrete) is bulk formed by breaking apart. The cement comes from converting operations in large cakes. These cakes are bulk formed into fine powder by grinding.

Bulk forming paper from wood pulp requires several pushing-together operations. Wood pulp is produced by refining and converting operations. The pulp is made of tiny wood fibers and water.

Fourdrinering is a bulk forming operation used to spread the pulp into a sheet (Fig. D). This operation also helps drain water out of the pulp.

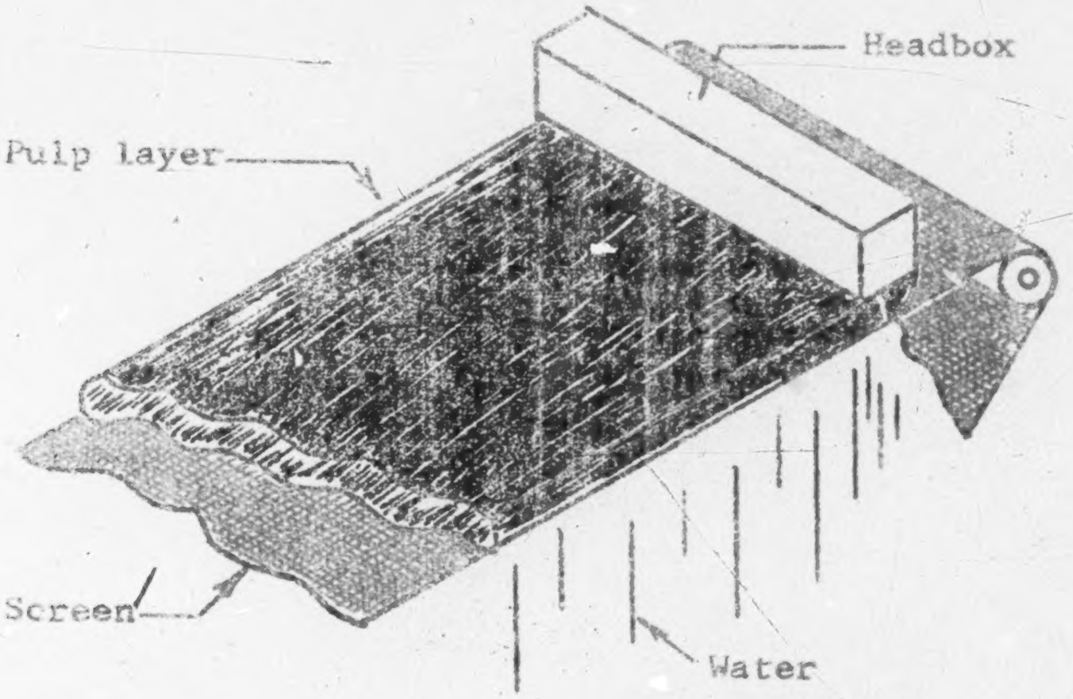


FIG. D FOURDRINIERING: In the headbox, pulp is sprayed onto a moving screen. The belt-like screen carries the pulp away from the headbox in a thick sheet. Water drains through the screen.

Pressing the sheet of pulp changes its thickness (Fig. E). The pressing operation bulk forms the material by pushing the fibers together.

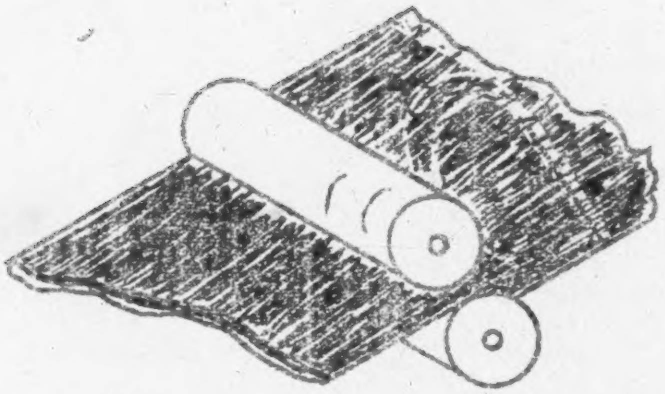


FIG. E. PRESSING

Drying the sheet is done by passing it over several rollers (Fig. F). The rollers are heated by steam. Heat from the steam makes water evaporate from the paper.

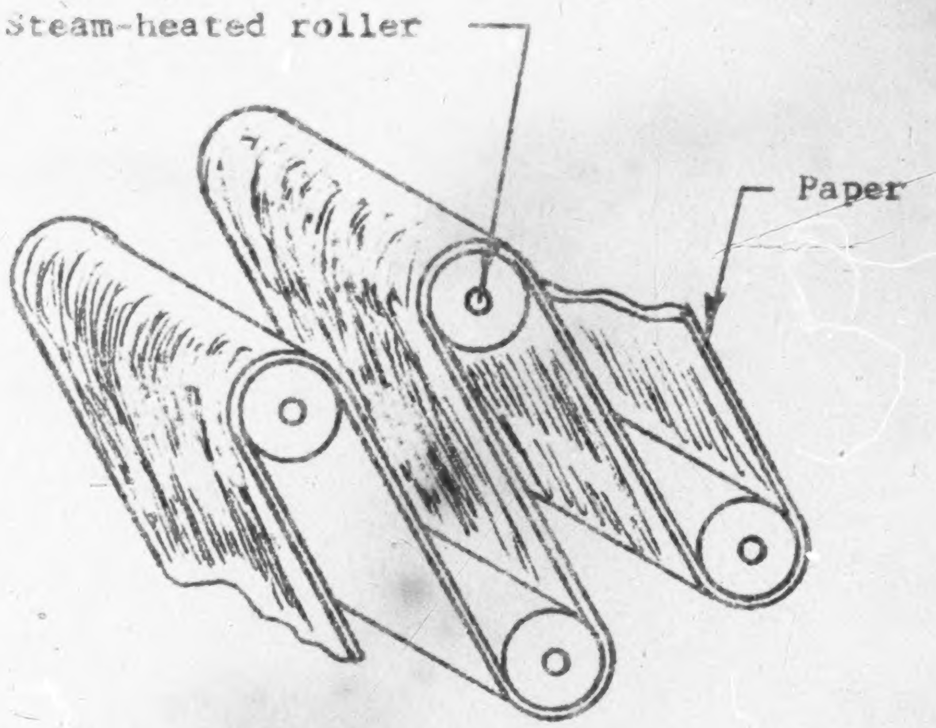


FIG. F. DRYING

Calendering squeezes the paper between two smooth rolls (Fig. G). This forms a smooth surface on the paper.

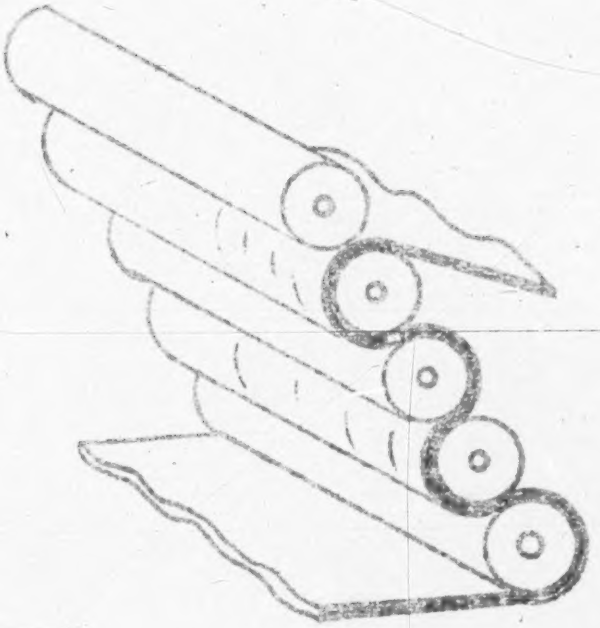


FIG. G. CALENDERING

Winding the sheet forms the paper into a large roll (Fig. H). Trimming makes all of the rolls the same width.

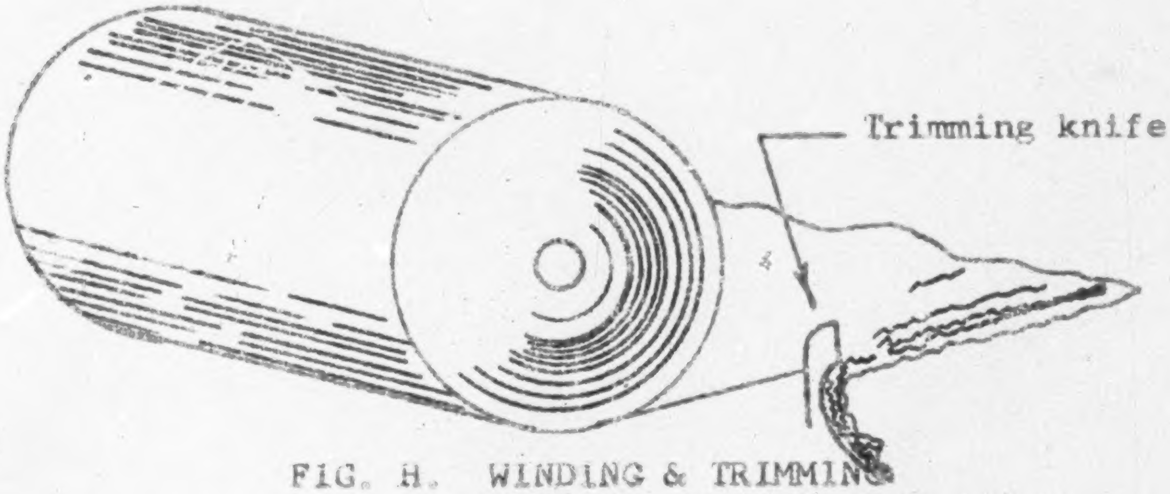


FIG. H. WINDING & TRIMMING

Bulk forming of steel also uses mechanical operations. When steel comes from the furnace it is poured into molds. The molds are called ingots. Cooling the steel forms it into ingots.

Rolling changes the ingots into shaped pieces of steel called slabs (Fig. J).

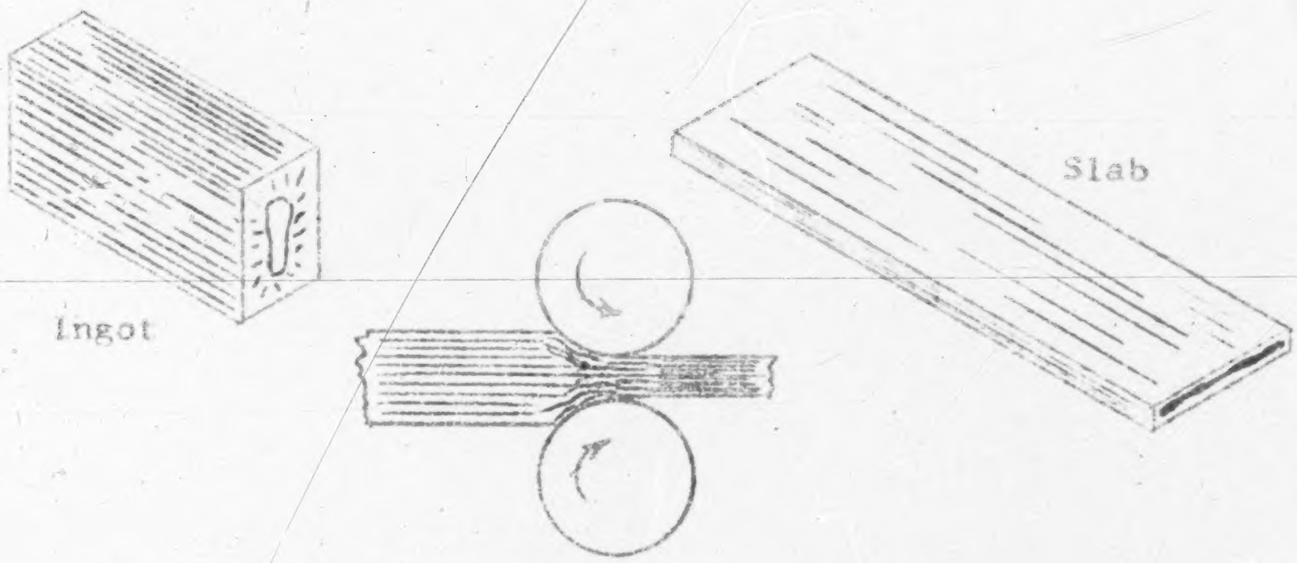


FIG. J ROLLING STEEL INGOTS INTO SLABS: Ingots are rolled back and forth between the rollers until thinner slabs are formed.

Cotton is bulk formed by several mechanical operations. Baling bulk forms 500 pounds of cotton into a bale. When bales are opened the cotton is carded. Carding helps refine the cotton. It also forms the cotton fibers into a rope-like strand called a sliver. Roving machines form several slivers into a larger strand. Spinning machines stretch the strand and form it into a thin thread. Spinning machines also twist the thread to make it stronger. Winding machines bulk form the thread onto a spool.

BULK FORMING BY HEAT

Heat forming examples have already been given. Iron is formed into pigs by losing heat (cooling). Steel is formed into ingots as it loses heat (cools). Paper is dried by heating and mechanical pressure.

BULK FORMING BY CHEMICALS

Chemicals can be used to bulk form materials. Coagulation is a bulk forming operation that uses chemicals. Materials are coagulated (made thick and hard) by passing them through chemicals.

Rayon thread is an example of a bulk material formed by coagulation (Fig. K). Liquid rayon is squeezed through tiny holes in a die. This forms liquid threads of rayon. The liquid threads pass into an acid bath. The acid coagulates (forms) the liquid threads into solid threads.

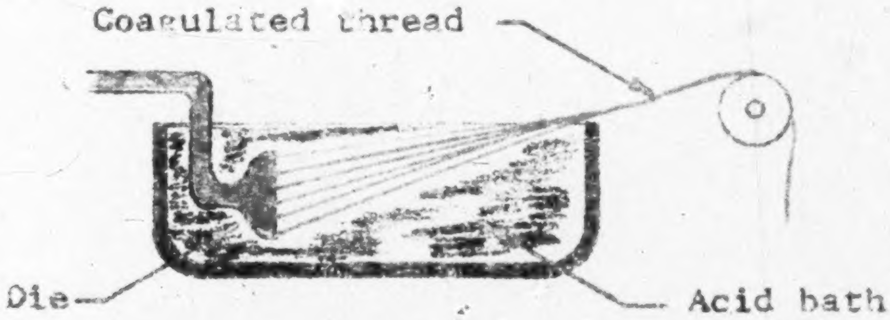


FIG. K COAGULATION OF RAYON

BULK FORMING BY ADDING MATERIALS

Adding new materials to the bulk helps some bulk forming operations.

Finishing is a bulk forming operation used to make paper and cloth. Finishing is done by adding materials called resins to the bulk material. The resins form a better surface on the paper or cloth.

Starching is ~~very similar~~ to finishing. Starching is done by adding starch or other man-made materials to the bulk. Starched cloth holds its form much better than cloth with no form-holding material added.

THE IMPORTANCE OF BULK FORMING

Bulk forming is done for two major reasons. It improves the quality of refined and converted materials. Bulk forming also produces stock materials of standard sizes and shapes.

Paper, cotton yarn, and cement are all improved by bulk forming after refining and converting.

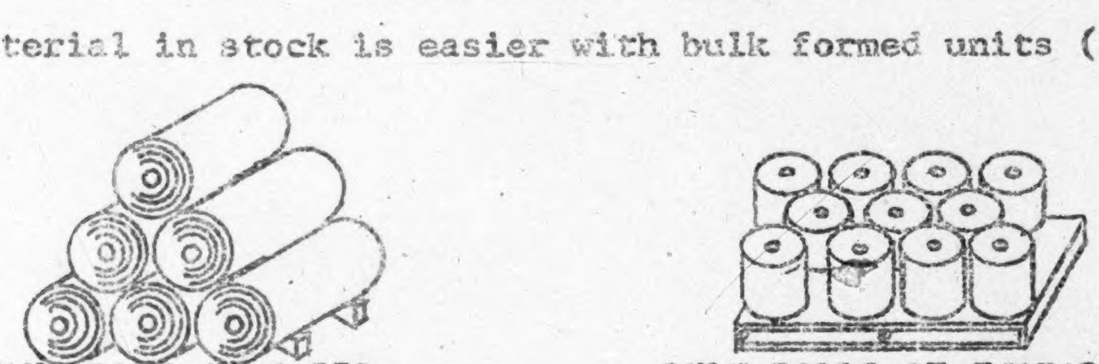
Paper pulp is changed from a soggy mass of fiber and water to a sheet.

Cotton fibers are made strong by stretching and twisting in the roving and spinning operations.

One secret of making good cement is grinding it into a fine powder. Fine powder mixes evenly with other materials in the concrete. The even mixture helps the cement hold the concrete together.

Uniform sizes and shapes make materials easier to handle. Stock materials take up less space in the supply room. They are easier to transport from one factory to another. Less material is wasted when it is bulk formed into uniform sizes and shapes.

Bulk forming stock materials makes it easier to order a certain amount. Inventorying (counting) the amount of material in stock is easier with bulk formed units (Fig. L).



BULK ROLLS OF PAPER

BULK ROLLS OF THREAD

FIG. L

Stock materials can be bulk formed to fit certain machines. An 8 ft. roll of paper will fit a certain printing press.

Bulk forming stock materials saves time in later processing. Large rolls of paper can be used instead of small ones. This means that the rolls will not need to be changed as often.

SUMMARY

Bulk forming is a primary processing operation. The bulk is the large mass of material which comes from refining and converting operations. Forming means changing the size, shape, or form of the material.

Bulk forming can be done mechanically by pushing material together or breaking it apart. Also, heat and chemicals are used to bulk form materials. Sometimes new materials are added to bulk form materials.

Examples of bulk forming operations are: grinding, fourdriniering, pressing, drying, calendering, winding and trimming. Other operations are: cooling, rolling, baling, carding, roving, spinning, condensing, coagulating, finishing, and starching.

Bulk forming is important for two reasons. It improves the quality of materials. It also makes stock materials of uniform size and shape.

Bulk-formed materials are not finished products. They become finished manufactured products by component processing and assembly processing.

LABORATORY ACTIVITY

Objectives. The student, after completing the laboratory activity, should learn:

1. How fourdriniering, pressing, and drying operations bulk form a material.
2. How bulk forming improves the quality of the material.
3. How bulk forming makes uniform sizes and shapes of stock material.

Introduction. Paper is a common example of a raw material produced by primary processing. The raw material, paper, is used for many purposes by a variety of companies after it leaves the paper mill.

As you do this activity you will not completely make paper. You will only bulk form the pulp into a sheet. The pulp that you will use was produced by refining and converting operations.

Materials needed.

1. Paper pulp (The paper pulp can be ordered directly from a paper company or made in the shop by breaking up facial tissue in water and adding a small amount of instant starch.)
2. Paper towels (Two per student.)

Equipment needed.

1. Basin or pan
2. Paddle
3. Frames (One for each group of students.)
4. Fine wire screens (One for each group of students.)
5. Rolling pin
6. Electric iron
7. Paper cutter

Procedure. After watching the demonstration, you will be divided into smaller groups. As each person forms his sheet, the rest of the group should watch. Follow the steps and answer the questions.

1. Stir the pulp with the paddle.
2. Place the frame over the screen (Fig. M).
3. Dip the screen and frame sidewise into the pulp (Fig. N).
4. Raise the screen straight upward. Then shake the screen sidewise (Fig. O).
    4.1 What happens to the water when the screen is raised out of the pulp?

    ____

    4.2 What has happened to the bulk of pulp left on the screen?

    ____

    4.3 What does shaking the screen do to the pulp?

    ____

    4.4 Is this operation refining, converting, or bulk forming? ______________
5. Remove the frame.
    5.1 What is the purpose of the frame over the screen?

    ____

6. Place the screen and pulp between two paper towels (Fig. P).
7. Roll the stack of paper towels, screen, and pulp with the rolling pin.
    7.1 What two bulk forming operations are done by the paper towels and rolling pin?

    a)______________ b)______________
8. Iron the stack with an electric iron.
    8.1 This is an example of bulk forming by

    ______________________________.
9. Remove the sheet of paper and trim it.
    9.1 What similar bulk forming operations happen at the end of the line in a paper factory?

    a)______________ b)______________

BULK FORMING PAPER

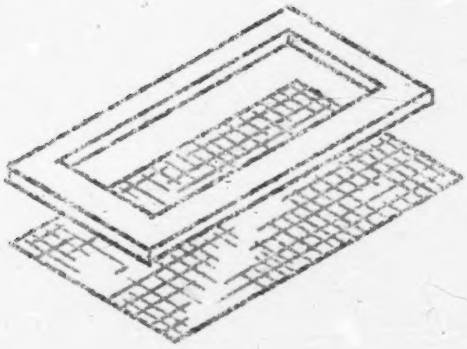


FIG. M
FRAME & SCREEN

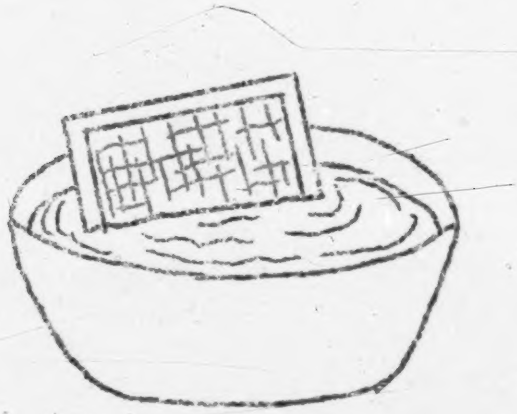


FIG. N
DIPPING INTO PULP

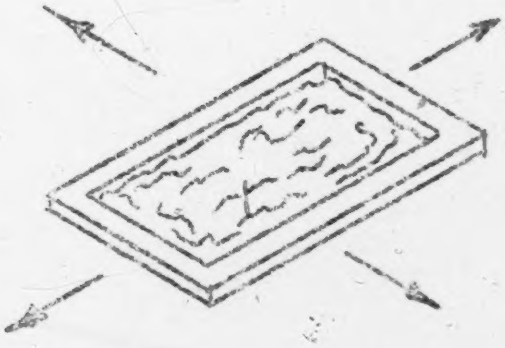


FIG. O
SHAKING

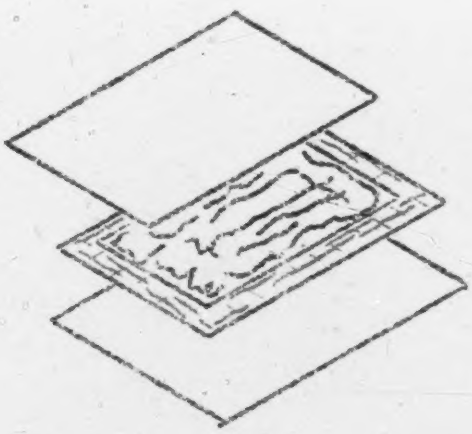


FIG. P
PLACING BETWEEN TOWELS

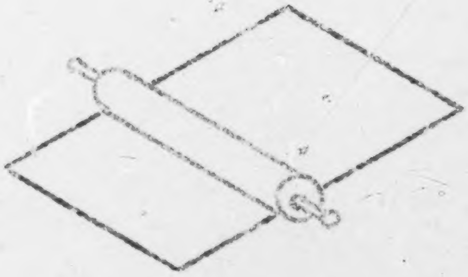


FIG. Q
ROLLING

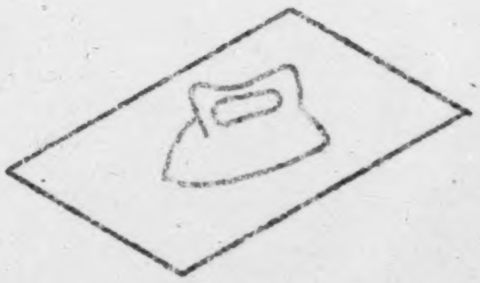


FIG. R
IRONING

9.2 How has bulk forming improved the quality of the material?

____

____

9.3 Name three things your sheet of paper might be used for after it is bulk formed.

a)________________ b)________________

c)________________

9.4 Will the size of the sheet determine how it is used? Explain.

____

____

BIBLIOGRAPHY

1. Crispin, Frederic S. Dictionary of Technical Terms. Milwaukee: Bruce Publishing Company, 1964.

2. Forbes, B. C. The Dictionary of Business and Industry. Norwood, Mass.: Plimpton Press, 1954.

3. Linton, George E. The Modern Textile Dictionary. New York: Meredith Publishing Co., 1963.

4. "Bulk-handling machines," McGraw-Hill Encyclopedia of Science and Technology (1966 ed.), II, 365-370.

5. "Paper and paper products," McGraw-Hill Encyclopedia of Science and Technology (1966 ed.), IX, 539-541.

6. "Textile," McGraw-Hill Encyclopedia of Science and Technology (1966 ed.), XIII, 532-542.

7. "How Paper Serves America," The New York Times, October 17, 1965.

8. How You Can Make Paper. Public Relations Division, American Paper Institute, 260 Madison Avenue, New York, New York 10016.

COMPONENT PROCESSING

OBJECTIVES

A study of Component Processing will enable the student to:

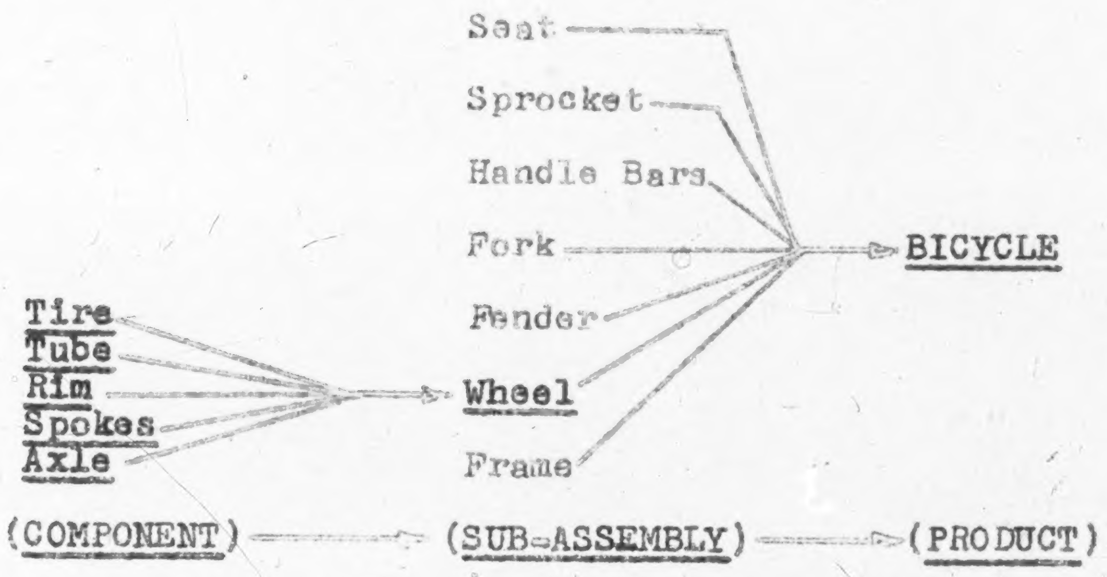
1. Recognize the difference between **Components**, **Sub-Assemblies**, and **Assemblies**.
2. Recognize the basic factors that influence **choice** of one process over another.
3. Identify the three major **processes** for forming components.
4. Understand the difference between the **two** general methods of **changing shape** of material.
5. Recognize the three **conditions** (states) a part may be in when processing takes place.

INTRODUCTION

Many manufactured goods are made up of more than one part. For example, a bicycle is a product made up of a number of single parts. The individual parts are called **components**. How many bicycle component parts can you name? (Hint: the **tire** is a component part of the wheel.)

Components are made from the industrial raw materials that result from **Primary Processing**. The **method** (way) of making these parts from industrial raw materials is called **Component Processing**. After component processing, all of the parts will be put together (assembled) with other components to form assemblies, or sub-assemblies.

In the case of a bicycle, the tire, tube, rim, spokes, axle, etc. form a **sub-assembly** called the wheel. Various sub-assemblies are then put together (combined) to form the finished **product**. (Fig. A)


Seat
Sprocket
Handle Bars
Fork
Fender
Wheel
Frame
BICYCLE
Tire
Tube
Rim
Spokes
Axle
(COMPONENT)
(SUB-ASSEMBLY)
(PRODUCT)

(Fig. A) Component Processing flow chart.

There are many ways to form component parts. In general, the materials from primary processing will be subjected to treatments (processed) to change their **shape** **properties**, or **both**. The spokes of a bicycle wheel, for example, are pulled through a metal die (drawn). This changes their properties (gives them additional strength), and also shapes them (forming). These treatments fall into **three** major catagories. They are (1) Separating, (2) Combining, (3) Forming.

1. Separating - Shaping parts by separating would be any process that takes material away from the original raw material. For example, you might have made models out of wood. (Cutting the parts out with a saw, or carving with a knife.) Removing the extra material was a **separating** operation.

2. Combining - Making components by combining is just the opposite of separating. Com-

bining means making the parts by mixing, or coating them. You have probably seen, or maybe have used, a tool with a handle coated with plastic or rubber. Coating the handle is an example of the **combining** process.

3. Forming - Forming is usually done by stretching or bending the material to change its shape. A basketball hoop starts as a piece of straight, round steel rod. It is then **formed** into a circle.

PROCESSING

Few goods are formed of one piece. The two main reasons for this are (1) cost, and (2) the need of various properties in different parts of a product. Most manufacturing companies **specialize** in one type (kind) of operation. They often have areas in their plants for making each component. In some cases, they have whole plants for making each different component part. Sometimes however, because of cost, less experience and machines, they have other companies make component parts for them. (For example, it might be cheaper for an automobile maker (manufacturer) to buy tires from a company that makes only tires.) In any case, the manufacturer will have to go through a number of steps in component processing before delivery of a finished part. Two of the main steps can be called **Selecting the Process**, and **Changing the Shape**.

SELECTING THE PROCESS

There are a number of things that bring about the final choice of one process over another. **Design of**

the part will limit the processes by which the component may be made. Next, the **type of materials** needed to make the part will further limit process choice. Then, the **cost of production** (making the parts) will have a great deal to do with further selection of process. **Physical properties** (appearance, surface finish, and hardness) also have an influence over the process used. The **number** of components to be produced will be a major part of selecting a process. These are just a few of the things that will help choose the process to be used in making a component.

It is no simple matter to decide which of several posible processes to use. In this respect, the management and production personnel are tied closely together in manufacturing. By using the thoughts of many people in the different jobs of industry, a wise decision can be made as to the best process. Whatever process that is selected will mean changing the **shape** and/or **properties** of the raw material that comes from primary processing.

CHANGING THE SHAPE

In general, one of two methods is used to change the shape of material to form component parts. One method would involve some **volume change** (amount of matter) in the raw material. This change could either be taking material away (separating), or adding material too (combining the component being formed. The other process deals only with shape change of the material, not volume change. This would include methods of deforming (stretching, twisting, and compressing) the material.

Many forms of energy may be used to change the shape of the material. The two most common forms are heat, and mechanical power. However, other energy forms are being experimented with or being used. These include chemical reaction, electrical energy, and light.

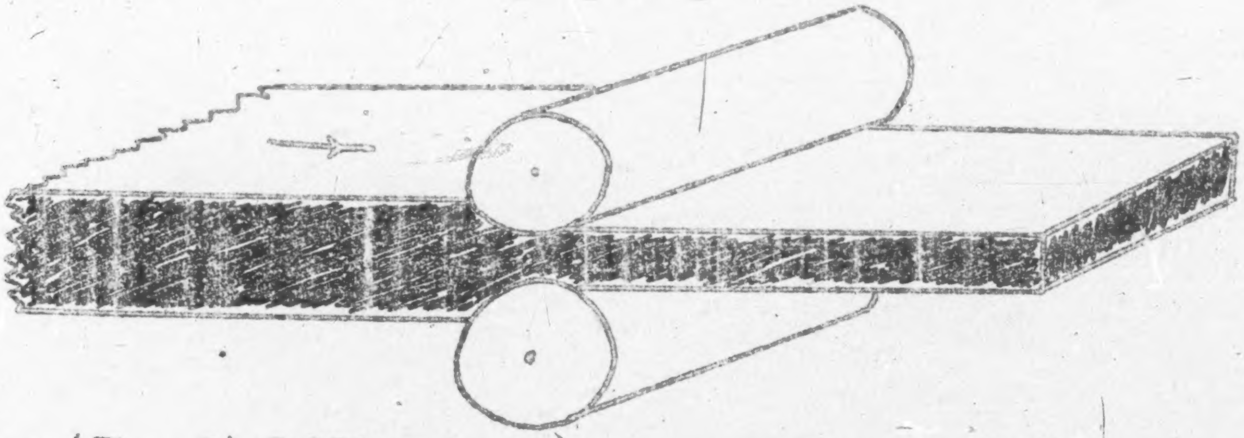
Changing the shape of the part can be done with the material in one of several different forms. The material can be in a (1) solid state (2) liquid state, or (3) plastic state.

Solid, With Volume Change - Changing the shape of material in a solid form often means some volume change will take place. In metalworking and plastics processes, for instance, it could be machining or shearing. Changing volume of a solid material in woodworking could be turning, planing, or jointing operations. Shearing in the garment (fabric) industry would be an example of separating a solid. Chipping stone away would be the same type of process in another industry. All of these processes have two things in common. They involve changing the volume of a material that is in a solid condition.

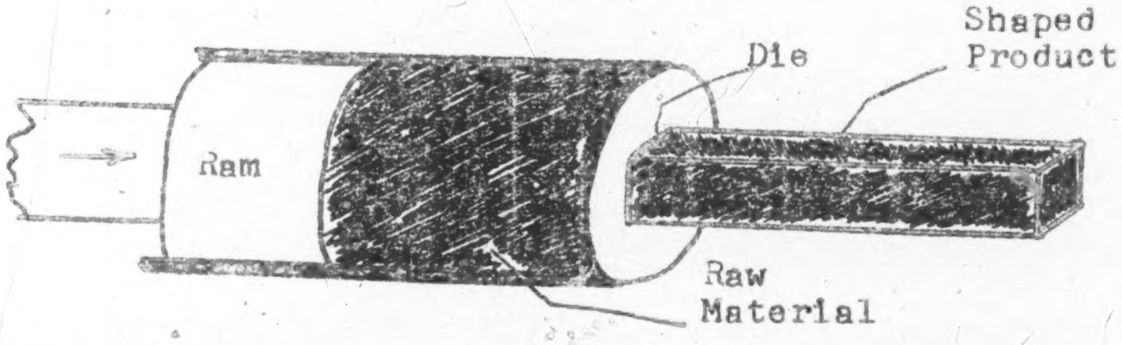
Solid, With No Volume Change - Sometimes, shape changing processes are carried out without changing the volume of the material being worked on. These processes are ones such as bending, forming, and some pressworking operations. (The fender of a bicycle, for example, is made by stretching and bending a flat steel sheet). Processing involving forming **solid** materials **without changing volume** is also used in other industries. In some cases, plywood is formed to various shapes (chair backs) in an operation known as forming.

Liquid - When material is melted and formed while in a liquid state it is called **casting**, or **molding**. Casting and molding are processes that do not change the **volume** of the part. They just change the **shape**. Forming a figure of cement or plaster of paris is another example of processing that changes **shape** but **not volume**.

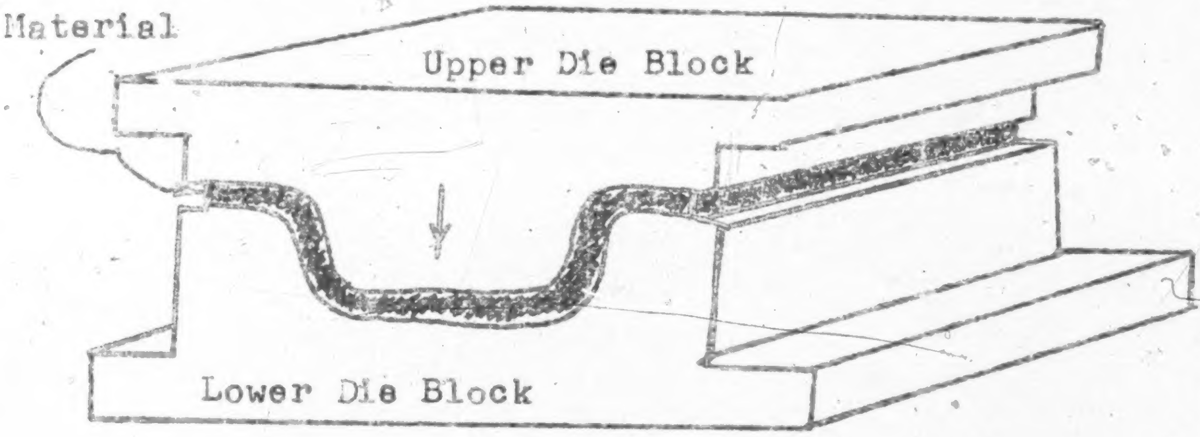
Plastic - Materials in a plastic condition are said to be **semi-solid**. That is, they are not solid, yet they are not completely liquid. Parts in this state would be formed by processes such as (1) Rolling (Fig. B), (2) Extruding (Fig. C), or (3) Forging (Fig. D).



(Fig. B) **Rolling** is the process of passing the material through rollers to change the shape of the part.


Shaped Product
Die
Ram
Raw Material

(Fig. C) **Extruding** is forcing material through a hard metal die (shaped hole) to shape components.


Material
Upper Die Block
Lower Die Block

(Fig. D) **Forging** is forming the material with heat and/or pressure.

Again as in the liquid form, materials in a plastic condition would just have their **shape** changed, **volume** would **not** change. Extruding clay (pushing through a formed metal die) t o form brick is an example of working material in the plastic state.

SUMMARY

Component is the name given to **one** individual part that goes into making up a product. **Component Processing** is the **method** of making components from the industrial raw materials from Primary Processing. Components are put together (assembled) to form **Sub-Assemblies** or **Assemblies**. The sub-assemblies or assemblies are then joined to form a **product**.

There are several things that limit the **choice** of one method of processing or another. Some of these things are design, type of material, cost of making the parts, physical properties if materials used, and number of pieces to be made. Sometimes companies find it cheaper to buy a certain component than to make it themselves. Ordinarily however, they make the part themselves in **specialized** areas of their plants.

In almost all cases it is necessary to change the shape of materials that come from Primary Processing before they are useable as components. This is, in general, done by one of two methods. One method consists of actual **volume change** of the material, while in the other method only the **shape** is changed. Examples of processes that involve **no** volume change in the material would be **Forming** operations. Processes that **would** include volume change in the material would come under the heading of **Combining** or **Separating**. Shape changes take place with the part in one of three conditions (states) They are (1) **Solid**, (2) **Liquid**, or (3) **Plastic** (semi-solid).

LABRATORY ACTIVITY

Objectives - The labratory activity will aid the student in:

1. Identifying of components, sub-assemblies, and assemblies.
2. Gaining experiences through making various components, and using different processes. These experiences will then be the basis for which later choices can be made.
3. Considering the basic factors in producing a component and making the best choice of processes, materials, and tools to use in making a part.

Activity #1 - Identification of Components, Sub-Assemblies and Assemblies.

Materials:

1 Overhead Projector

20 Transparencies

1 Screen

Project various pictures of components, sub-assemblies, or assemblies onto the screen. Have students write out or answer verbally identifying each one as to whether it is a component, sub-assembly, or assembly.

Activity #2 - Component Processing of Plastic Parts.

Materials:

4 Vacu-Form Machines

4 Molds for Boat Body

4 Molds for Boat Top

40 Sheets of Plastic 4" X 4".

Have groups of students form component parts (body and top) of model boat of vacu-form machine. Component Processing shown will be related to (1) Forming a semi-solid material, involving *no* volume change (shaping over the pattern molds), and (2) Shaping a solid material involving volume change (Shearing the excess material from the edges of the body and top). Parts may be used later in unit on assembly.

Activity #3 - Component Processing of Memo Pad Parts.

Materials:

4 Centerpunches
4 Hammers
1 Handpunch
4 Files
1 Drillpress
1 Bar Folder
1 Box & Pan Brake
1 Squaring Shear
1 3/16" Drill
1 3/8" Rod
2 Vices
1 Body Pattern
1 Clamp Pattern
20 pc. 20 Guage Galvanized 4" X 8½"
20 pc. 20 Guage Galvanized 1½" X 4"

Set up two assembly lines to make the two component parts of the memo pad holder (one line to make one part). Processes shown will be *Separating* (*drilling* the holes in the body, *shearing* the corners from the body, *punching* the holes in the clamp, and *filing* the edges of both), and *Forming* (*rolling* the end of the body to make the pencil tray, and *bending* the ends of the body and clamp).

At this point it may be reëmphasized that some components (machine screws and nuts) are cheaper to buy than to make. Parts may be used later in an assembly unit.

FILMED FROM BEST AVAILABLE COPY

SEPARATING

OBJECTIVES

The pupil, after studying this lesson, should be able to:

1. Explain separating and [illegible] which are separating.
2. Give three reasons why tools are used for separating.
3. Name five tools used by hand for separating.
4. Name five tools for separating that are [illegible].
5. Explain why separating is important in manufacturing.

INTRODUCTION

Almost everything manufactured today is made of smaller parts called components. The components of a pair of roller skates are the frames, axles, wheels, straps, and shoe clamps. Some components, in turn, are made of still smaller components. A shoe clamp for roller skates is made of two side pieces, with different shapes, and their adjusting screw. Making individual components, such as an adjusting screw, is called component processing.

One very important way to make components is by separating. Separating is reducing the size of a solid material. You see separating done many times each day. Cutting a slice of bread to make your breakfast toast is separating. Cutting some butter for the toast is separating (Fig. A). Even biting the toast is separating. What did your

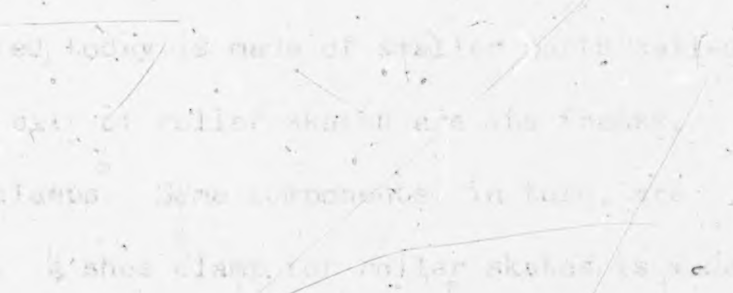


FIG. A Separating: cutting some butter for the toast is separating.

2

SEPARATING

father separate when he shaved this morning? What does your mother separate when she starts to make a new dress? What other acts of separating have you seen?

We will divide all acts of separating into three main groups. One group is separating by using parts of your body only. Biting off your toast is in this group. (Fig. B) Another group is separating by using a tool which cuts with the physical power your body supplies. Cutting the butter with a knife is an example of the second group. Can you think of other separating tools which are held in your hand? The third group is separating with tools that use more physical power than your body can provide. Power-operated shears can cut through 3/4-inch steel plate. (Fig. C)

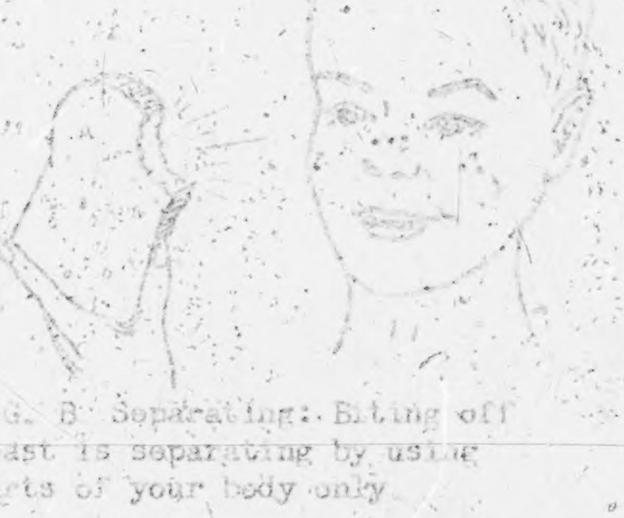


FIG. B Separating: Biting off toast is separating by using parts of your body only.

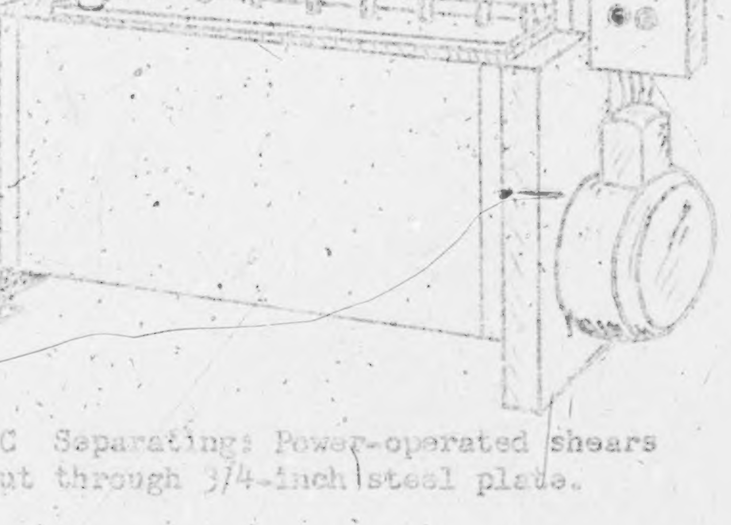


FIG. C Separating: Power-operated shears can cut through 3/4-inch steel plate.

SEPARATING WITHOUT TOOLS

Some materials used in manufacturing, such as paper, can be separated by tearing or ripping without tools.

SEPARATING

Some food products, such as oranges or bananas, can be separated by peeling with your hands. You can separate a small stick by snapping it between your hands or over your knee. Can you suggest other examples of separating by using only your body?

Separating without tools is suitable only if the material is small or weak. A twig is easily snapped but a big limb would be difficult. Hand separating often leaves a ragged and uneven edge. Torn paper is seldom neat or even. Some separating jobs would be very slow if you could not use common tools. How long would it take to peel a potato if you had no tools? Can you suggest a better way to separate the peel from the potato than by using your hands alone?

SEPARATING WITH HAND TOOLS

Hand tools were invented to help do jobs like separating more efficiently. You can separate butter with a knife much better than with your fingers. Various saws are helpful when the task is separating wood. Many tools make the job of separating simpler. A hand drill separates by producing holes. (Fig. D) Hand tools are those which depend upon your moving hands to supply the force that causes the separation. Have you ever used any hand tools that were designed for separating paper? Would these tools separate other materials efficiently? The strength of the operator is one

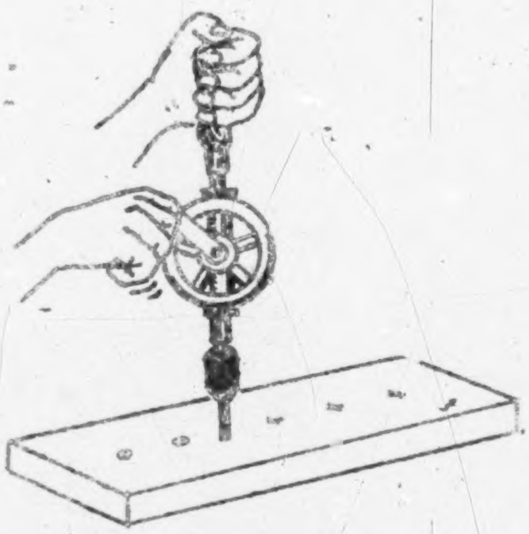


FIG. D Separating: A hand drill separates by producing holes.

limitation of hand tools. Can you think of other limitations? How can we overcome these limitations?

SEPARATING WITH MACHINE TOOLS

Separating with machine tools is very important in modern industry. Machine tools are those using some force other than man's strength for operation. With machine tools we can separate even very hard materials, such as steel, with great ease. The time required for separation is much shorter with machines. Also, machine separation generally leaves a much neater edge than other methods. It is for these reasons that machines are so important in manufacturing today.

However, separating with machine tools has its disadvantages. Any machine will cost more to buy and to repair than a hand tool. Operating machines requires more skill. Machines are not easily moved around. But the good features of separating with machine tools outweigh the disadvantages. What machine tools for separating do you see in our shop? What other machine tools can you name?

Some machine tools for separating in industry are much more complicated than the ones in our shop. Some heavy metal parts are separated by burning a path using acetylene and other gases. (Fig. E) Have you ever seen a welding torch? Strong chemicals are also used to separate metals. The plate for making pictures on a printing press

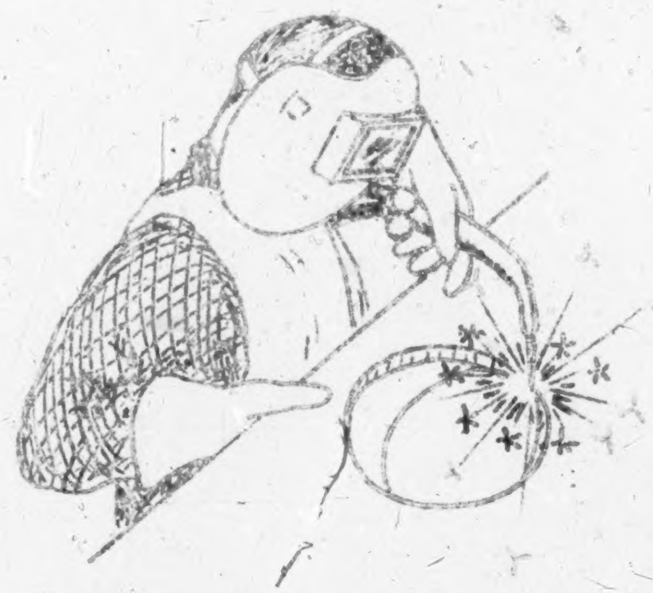


FIG. E Separating: Some heavy metal parts are separated by burning a path using gases.

can be made by chemical etching. Electricity is also being used for special separating jobs which are difficult to do with any other method. Holes can be made with the electrical discharge machine to the exact shape of the electrode. Still other machines are being developed to do the separating in industry. Perhaps you can help design a new separating machine some day.

SUMMARY

One of the most important methods for component processing in industry is separating. Separating means reducing the size of a solid material. Shaving off whiskers, peeling an apple, and whittling a stick are common examples of separating. Some separating, such as tearing paper, can be done without the use of tools. Using the proper tool adds efficiency to separating by doing the job easier, faster, or neater. Hand tools are those which depend upon your moving hands to supply the force that causes the separating. Cutting paper with a pair of scissors is separating with a hand tool. Machine tools use some force other man's strength for operation. Machine tool separating is very important in manufacturing today. New machine tools for separating are being developed.

LABORATORY ACTIVITY

Objectives

The pupil, after doing this activity, should be able to:

1. Name four methods of separating clay and similar materials.
2. Name three things to help decide the best way to separate.
3. Decide on the best way to separate clay and similar materials.

SEPARATING

Problem

Almost all materials can be separated in more than one way. Some ways are better than others. We will separate clay with four different methods and decide which method is easiest, fastest, and neatest.

Material

Four balls of clay will be used. They should be about the same size.

Tools and Equipment

1. A scrap board on which to work.
2. A small saw.
3. A knife.
4. A thin wire stretched tight. (A coping saw frame can be used.)
5. A rag to clean the tools.
6. A chart made out as follows:

Method No.	Tool Used	Easy	Fast	Neat
1	None			
2	Saw			
3	Knife			
4	Wire			

Procedure

1. Pull or twist one ball of clay apart using just your hands. Think about how easy, fast, and neat clay separates by hand.

2. Saw through a second ball of clay.. Take care not to saw your fingers. Decide if sawing is easier, faster, or neater than the first method.

3. Cut through a third ball of clay with a knife. Watch out for

your fingers. Decide if the knife was easier, faster, or neater than the the first two methods.

4. Cut through the last ball of clay with the wire. You can move the wire or the clay or both. Decide if wire-cutting is easier, faster, or neater than the first three methods.

5. When you have made up your mind about the three things we are considering, put the clay back together and clean the tools with the rag.

Recording

1. On the chart under "Easy" put an A on the line of the method you think was easiest. Put a D on the line of the method you think was the hardest. Put a B and a C on the other two lines to show how you rate their ease of separation.

2. On the chart under "Fast" put an A on the line of the method you think was fastest. Put a D on the line of the method you think was the slowest. Put a B and a C on the other two lines to show how you rate their speed of separation.

3. On the chart under "Neat" put an A on the line of the method you think is the neatest. Put a D on the line of the method you think looks the worst. Put a B and a C on the other two lines to show how you rate their neat separation.

4. Look at the grades you have given each method. Draw a circle around the number of the method that has the best grade average.

5. Below the chart write the names of other materials which you think could be cut like clay.

COMBINING

OBJECTIVES

The student after studying this unit, should understand:

1. Component processing is the making of component parts from industrial raw materials.
2. Combining is one of three ways of making components. The other two are separating and forming.
3. The concept of combining in the manufacturing of ceramic tile.
4. The difference between mixing and coating and why both are important to industry.

INTRODUCTION

Manufactured goods are important in our lives. Just look around you at this monent. Other than the natural world (including people), everything else is either constructed or manufactured. Life as we know it today would be quite different if it were not for manufacturing.

Many manufactured products are made of components. Components are made from industrial raw materials. Making component parts from industrial raw materials is called component processing. Three ways of making components are separating, combining, and forming. Making components by combining is done by mixing and /or coating.

The manufacturing of ceramic tile is an example of combining industrial raw materials by mixing and coating. (Fig. A). Combining occurs for example in the mixing of the glazes. Brushing or spraying glazes then involves coating the tiles.

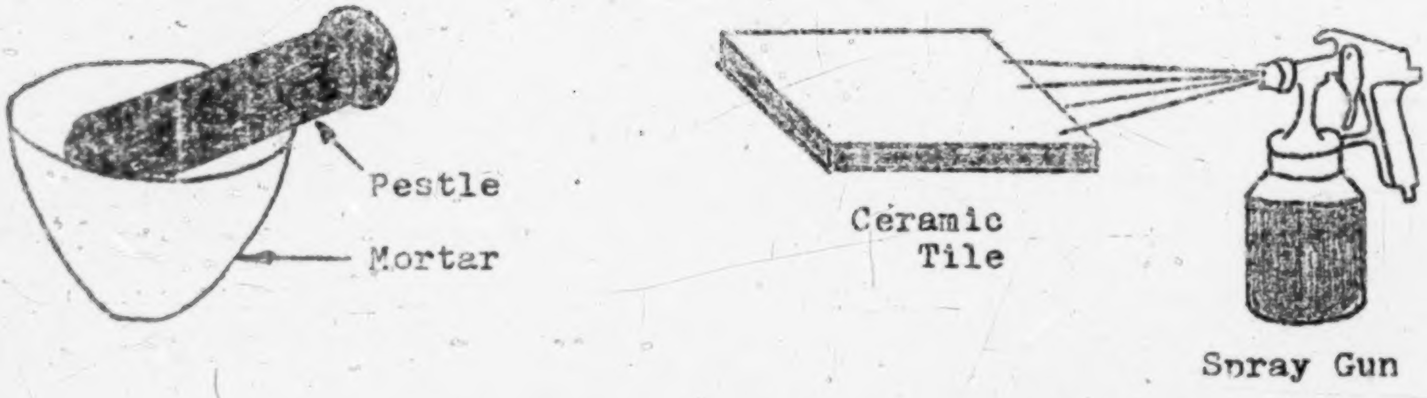


FIG. A. Combining industrial raw materials. Mixing glaze with a mortar and pestle; and coating by spraying the glaze on a ceramic tile.

Remember, all component parts of industrial products are made in one of three ways; separating, combining and forming. And, industrial raw materials are combined by mixing and coating.

MIXING

You are probably familiar with how a cement mixer works. (Fig. B). Measured quantities of sand, gravel, cement and water are placed in a rotating chamber. After they are thoroughly mixed the material for concrete is produced.

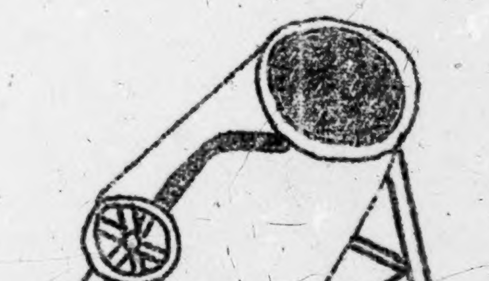


FIG. B. Cement mixer. Used to mix measured quantities of sand, gravel, cement and water.

This same process is true for mixing cake batter except the end product is quite different. Here the mixture depends upon what kind of cake you want. One mother will add cocoa for a chocolate cake, or extra eggs for angel food, or lemon for flavoring. In all cases the dry and wet ingredients must be mixed together thoroughly before an end product can be achieved.

In the paint industry, pigments and oils must be combined properly to produce desired colors just as dyes used to tint cloth for clothing must be mixed for the same reason.

These examples are used to show that mixing is important to manufacturing.

COATING

When you butter bread you coat the bread with butter using a knife. In the same way a coating is applied to sheets of plastic by knife or spread coating. (Fig. C).

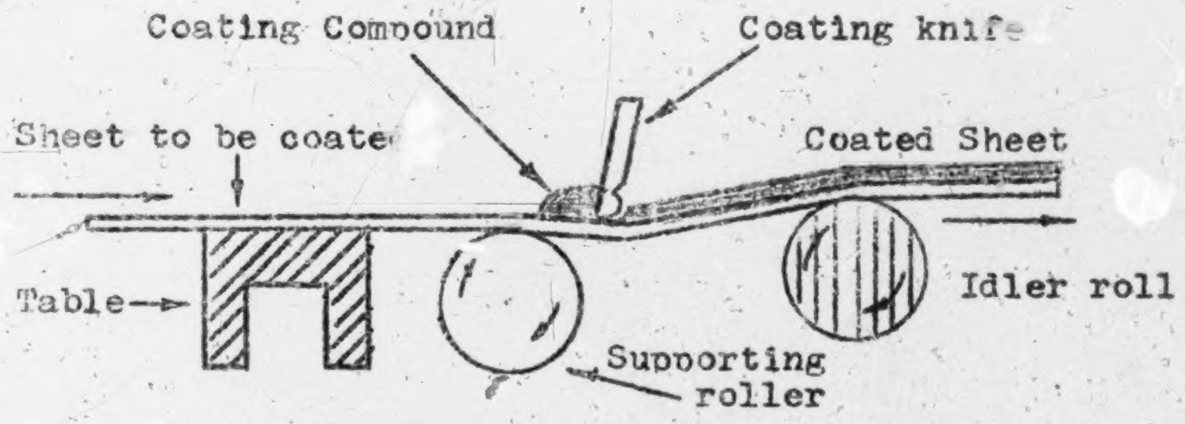

Coating Compound
Coating knife
Sheet to be coated
Coated Sheet
Table
Idler roll
Supporting roller

FIG. C. Knife or spread coating a plastic compound (glue) to sheet plastic.

In spread coating, the plastic to be coated passes over a roller and under a long blade or knife. The plastic coating compound (glue) is placed on the sheet plastic in front of the knife and is spread. The thickness of the coating depends upon the speed at which the plastic sheet is drawn under the knife and the position of the knife. Other methods of coating on plastic include spraying, dipping and brushing.

By coating one substance with another, certain desired effects are achieved. Painting your home protects the wood from moisture and rotting. Painting a car protects the metal from rust and corrosion. In both cases beauty is accomplished as well, although it is not the main reason for painting. Painting then is both practical and pleasing.

A much newer process for coating products is Teflon. By covering pots and pans with it, dish washing is made easier. Food is prevented from burning and sticking.

SUMMARY

Manufactured goods are important to today's world. Many items could not be produced without combining components to form useful products.

Combining can be achieved in several ways. The two important ones are mixing and coating.

In mixing, several materials are stirred together to gain desired results. In coating, the paint finish on a car or compound (glue) onto plastic sheets creates a different effect. Both processes have many values for modern industry.

LABORATORY ACTIVITY

Objectives

1. To show the student how abrasive paper is manufactured by viewing a filmstrip.
2. To teach students how abrasive paper is made by gluing grit to paper.

Materials

1. Six pounds of fine abrasive grit.
2. One 3" x 5" index card per student.
3. One quart of sodium silcate glue.
4. Four one inch flat paint brushes.

Equipment

1. Construct four each of the following apparatuses for making abrasive paper. (Fig. D).

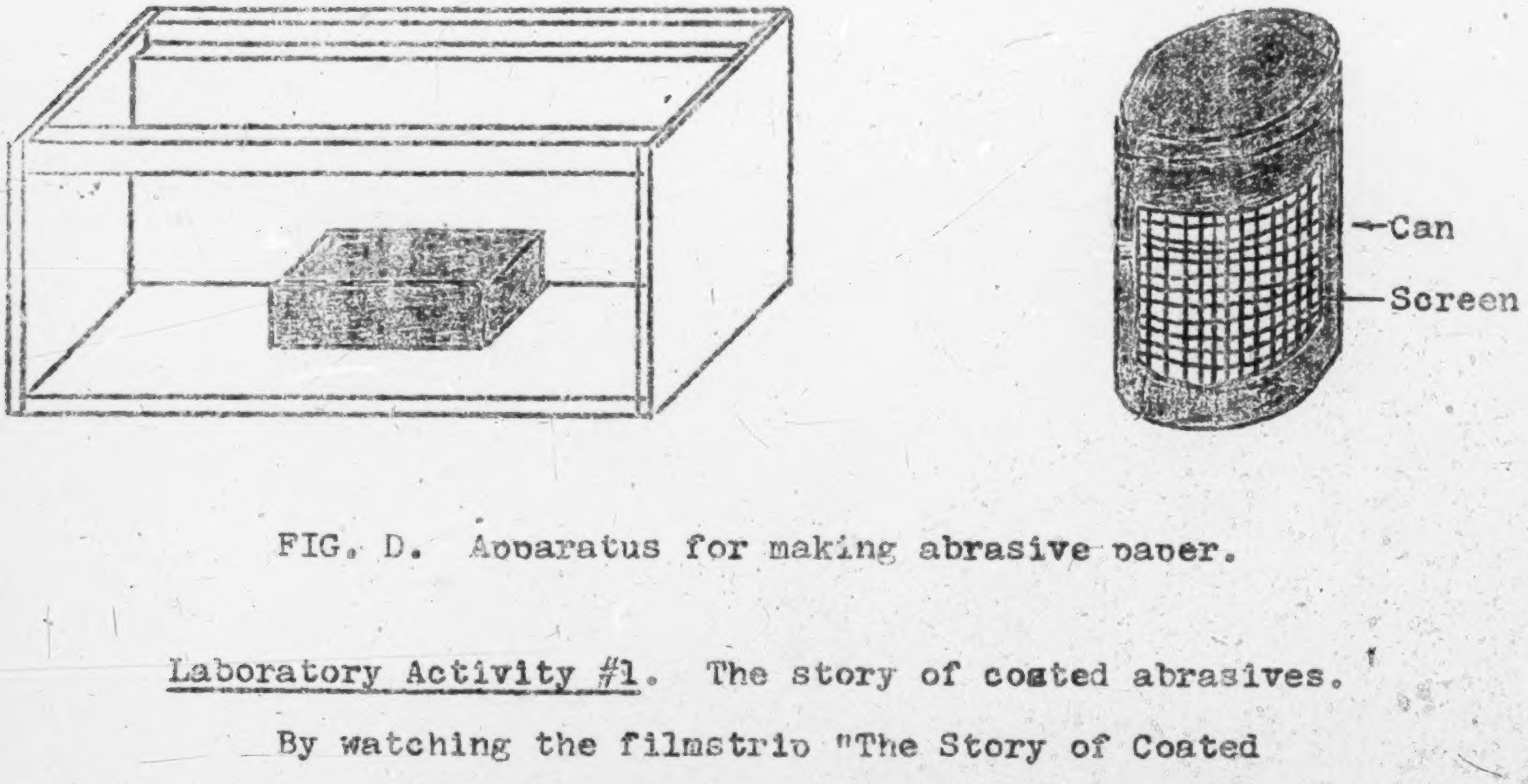


FIG. D. Apparatus for making abrasive paper.

Laboratory Activity #1. The story of coated abrasives.

By watching the filmstrip "The Story of Coated Abrasives", you will learn about the processes of combining. At the end of the filmstrip you are to

At the end of the filmstrip you are to combine materials for the manufacturing of abrasive paper.

Laboratory Activity # 2. Manufacturing abrasive paper.

Introduction

Divide into four groups, six students per group. Six students will go to one of the four work areas in the shop. You will find the following materials on the table; (1) One apparatus for making abrasive paper, (2) Abrasive grit, (3) Glue, (4) One inch flat paint brush, (5) Six 3" x 5" cards and (6) One pencil. With one student working at a time, follow the steps of procedure.

Procedure

1. Write your first and last name on one side of the card.
2. On the side of the card opposite your name, apply a thin coat of glue. Use the one inch flat paint brush.
3. Place the card, glue side up, in the apparatus.
4. Remove the top of the can. Pour in a small amount of abrasive grit and replace the top.
5. Place the can on top of the apparatus.
6. Roll the can back and forth several times. Make sure you have coated your entire card with abrasive grit.
7. Lift card out, removing excess abrasive grit.
8. Place card on table to dry.
9. Remove can from the top of the apparatus. Remove top from can.
10. Pick up the apparatus, tip forward and pour excess grit into can.
11. Place the apparatus back on the table.

7

BIBLIOGRAPHY

Gerbracht, Carl and Robinson, Frank, UNDERSTANDING AMERICA'S INDUSTRIES, McKnight & McKnight, Bloomington, Illinois, 1962.

THE STORY OF THE PLASTICS INDUSTRY, The Society of the Plastics Industry, Inc., New York, 1966.

VISUAL AID

"The Story of Coated Abrasives", Society for Visual Education, Chicago, Illinois.

FORMING

GOALS FOR THIS LESSON

1. You should be able to explain how each of the forming techniques may be applied to one material.

2. You should be able to define what forming means as it applies to manufacturing.

3. You should be able to identify sketches of the various processes discussed in class.

4. You should be able to understand how forming fits into the total picture of component processing.

INTRODUCTION

Snowballs, ice cubes and ice cream are all shaped by forming techniques. When shaping a snowball in your hands, you are using a forming technique. In this lesson you will learn to identify various forming techniques.

You have learned that component processing is one of the phases involved in producing finished products. Forming is one of the functions that is done as a part of component processing. By definition forming means changing structure without changing mass. When making a snowball, you pack the snow and shape it without loosing any snow. Therefore, this is a forming operation.

CASTING

Ice cubes made in the refrigerator are a cast product. Ice cream is cast into a brick shape. Manhole covers are cast.

The casting technique involves pouring liquid (water in the case of ice cubes) into a mold (the ice cube tray) and freezing (reducing the temperature until the liquid changes into a solid). When plastics and concrete are cast, the last step is curing. This means that chemical reaction in the material causes hardening. An example of this kind of product would be a concrete stepping stone.

The solid shape (ice cube) which results from this process is called a casting.

When casting metal parts, it is necessary to heat the metal until it melts. Then it can be poured into a specially prepared mold. This mold holds the metal until it freezes.

Below are sketches which illustrate the casting process using metal as the casting material. The flask is ready to receive the liquid metal. (Fig. A). The flask is a frame which holds the foundry sand. The

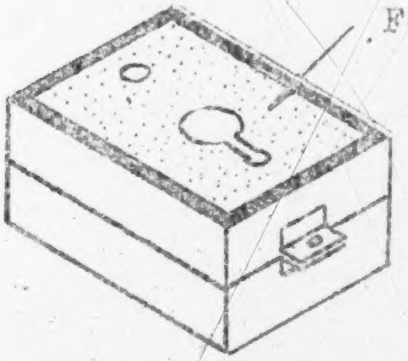


FIG. A Flask
Ready for Pour

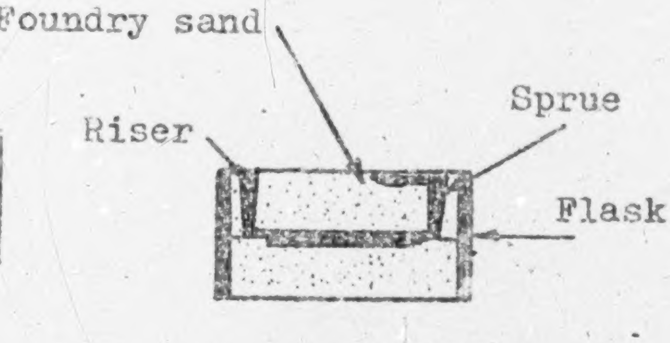


FIG. B Flask
Interior View

foundry sand provides a fireproof mold to receive the liquid metal. The flask has been cut in half to show the interior of the mold. (Fig. B). Again, you see foundry sand. The drawing also shows the mold cavity, which has been made the desired shape. The sprue is the hole through which the liquid metal will flow into the cavity. A riser is used to allow air to escape. This way the mold fills completely. The part that is shown in red becomes the casting.

When the casting is removed from the sand it would be a cast manhole cover. (Fig. C). The riser and sprue

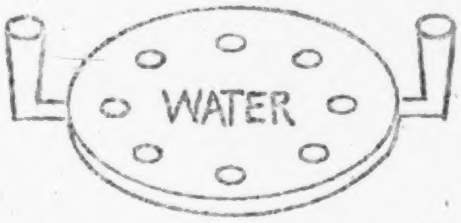


FIG. C Cast Manhole Cover
With Sprue and Riser

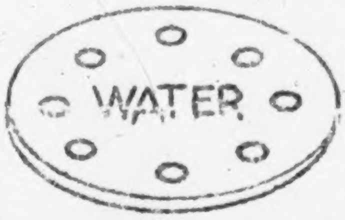


FIG. D Cast Manhole Cover
Finished Casting

are removed to produce a finished casting. (Fig. D).

There are special types of casting processes which are used to solve many problems. For example, the interior door handles on automobiles are die cast (metal is forced into a mold under pressure). Other processes include injection molding (a process of shaping plastics which is like die casting), and slip molding (a process for making pottery). With all of these methods, this is the important thing to remember:

****

Casting is a forming process that involves putting a liquid material into a mold and allowing the material to become solid.

****

Many materials are formed by this process. Among them are plastic, metal, food products, rubber, clay and glass. Can you think of examples of products made by the casting process?

EXTRUDING AND DRAWING

When you squeeze on a toothpaste tube, you extrude toothpaste. The long cylinder of toothpaste is shaped by the round hole (die) in the end of the tube. If the shape of the die is changed, the extruded toothpaste will change shape.

Many industrial materials are produced by the extrusion method. Bricks are an excellent example. After the clay has been mixed properly, it is fed into an extruder (Fig. E). The screw forces the clay through

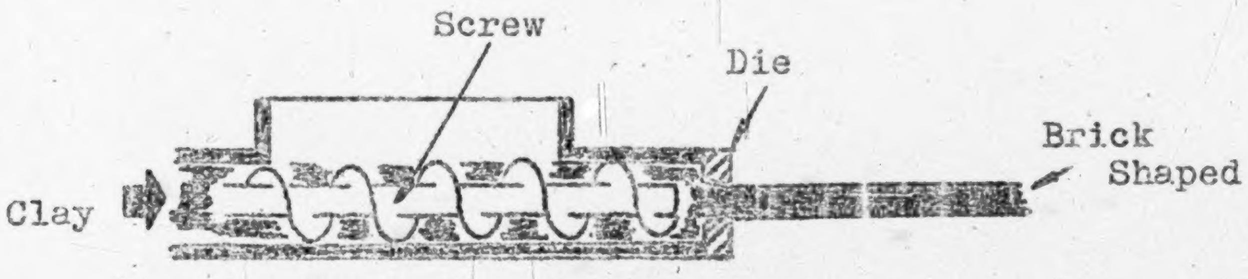


FIG. E Extruder
Interior View

the die forming a

the die forming a long rectangular shaped piece of clay. Later, the bricks are cut to length.

Tubing, plastic, cake icing and many more materials are extruded to obtain a shape.

Drawing of metal is basically like extruding. The principal difference is ~~that~~ the power to force the material through the die is a pulling action. Wire is drawn through a die to reduce its size. Each time the wire goes through a die it is reduced in diameter and lengthened. (Fig. F). None of the wire is lost. It is

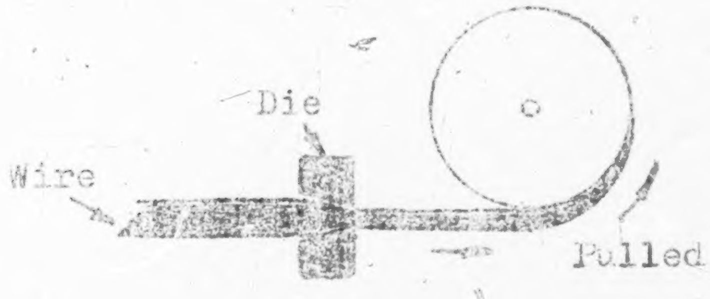


FIG. F Drawing Wire

simply squeezed into a smaller diameter.

VACUUM FORMING

Air pressure is used as a force to shape materials. In vacuum forming, the material to be formed is sealed over a mold. (Fig. G). The air in the mold is removed. As a result, the air pressure forces the material to conform to the shape of the mold. (Fig. H).

This process is commonly used with plastic. The

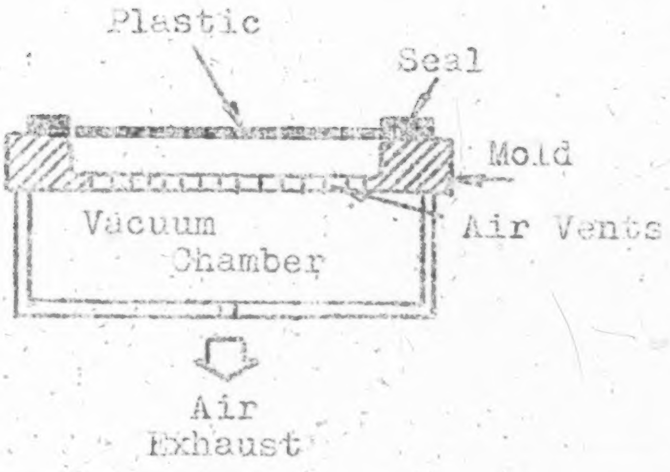


FIG. G
Vacuum Forming
Before Vacuum is Applied

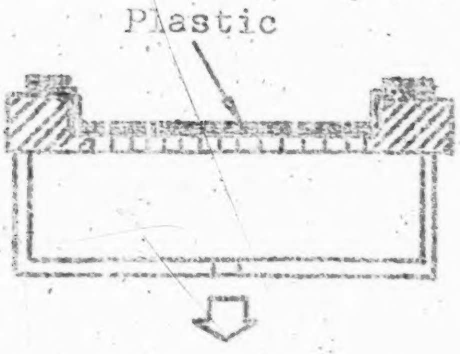


FIG. H
Vacuum Forming
Forming Finished

plastic has been heated so it can be shaped. After the plastic has cooled, the finished part is removed.

Shallow trays, picnic plates, signs and many other items may be made by this process.

ROLLING

Your mother forms pie dough to the proper thickness by rolling it with a rolling pin. Rolling will reduce the thickness of many materials. Metal, plastic and food products are examples.

Sheetmetal is rolled by two smooth steel rollers. (Fig. I). These rollers are held in a frame. The distance between the rollers determines the thickness of the sheetmetal.

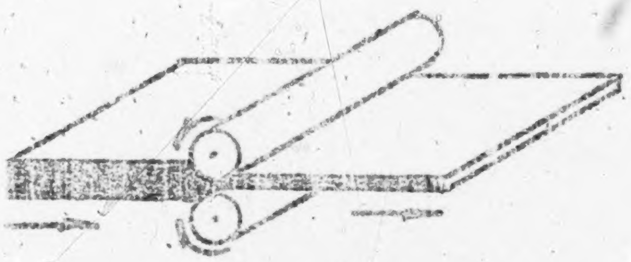


FIG. I Rolling Sheetmetal
Reducing Thickness

Rolling can be used to make other shapes. Railroad rails, I-beams and many other things are made through the use of specially shaped rollers.

Many other examples of rolling may be found. For example, glass and plastic are rolled to make the desired thickness. See if you can discover other rolled products!

BENDING

When you make paper airplanes, you perform a bending operation. Many things can be formed by bending. Thick metals and plastics need to be heated before they can be bent. Clay products and bakery goods are bent before they are heated.

Examples of products which are shaped by bending include metal file cabinets, cardboard boxes, metal funnels, and metal waste baskets.

Straight line bends such as those used in cardboard boxes are easily formed. Bending a flat sheet into a cylinder may be a bit more difficult to understand.

When working with sheetmetal, a device called a slip roll is used. (Fig. J). Basically, this machine consists of three rollers. (Fig. K).

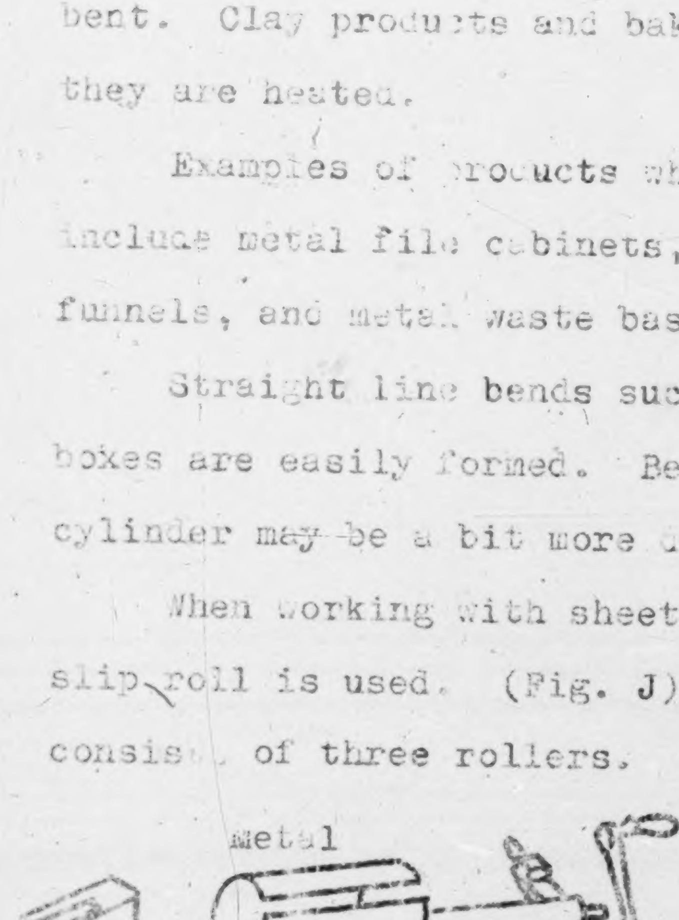


FIG. J
Slip Roll

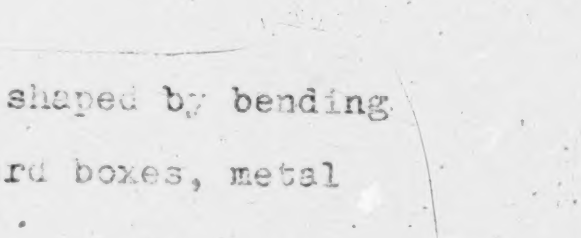


FIG. K Bending
With a Slip Roll

Since the third roller forces the metal up, it causes the metal to bend. By changing the position of the third roller, the curvature of the metal can be controlled.

SUMMARY

You have studied about forming. It is one of the types of operations that are used to shape products. There are many specific forming processes which we did not study. However, we have covered in a general way most of the major forming processes.

It should be understood that not all materials can be formed by any one of these processes. Each process does have its limitations and assets. These two reasons account for the fact that many specific forming techniques have been developed.

Remember!

Forming is a process of changing the structure of a material without changing its mass.

LABORATORY ACTIVITY

Goals

1. You should be able to recognize the forming processes used to make component parts of manufactured products.

2. You should be able to identify all the parts of a sand casting and explain their function in the casting process.

3. You should be able to make a sand casting of a simple product.

Activity I

The class should be divided into groups of four. Each group will be given a photograph or line drawing of a piece of shop equipment. The picture will have some parts of the equipment numbered. The students, working in groups, will determine by examining the equipment, what forming process was used to form the numbered parts. Record findings by number in the spaces below.

1. ____________ 5. ____________

2. ____________ 6. ____________

3. ____________ 7. ____________

4. ____________ 8. ____________

These findings should be checked immediately with the class members exchanging ideas and questioning each other about these findings.

Activity II

The instructor will demonstrate the sand casting technique of forming. If the students are to do

Activity III, this demonstration should follow that outlined procedure exactly.

Activity III--Sand Casting

Materials

- Flask
- Scoop
- Riddle
- Match plate
- Bench rammer
- Straight edge
- Molding board
- Sprue and Riser Pins
- Oil Tempered Foundry Sand

Directions

For this activity you will be grouped in fours. This will allow everyone an opportunity to participate in the activity and to see how all parts of the casting process are carried out.

Each student will be assigned one of the following job titles:

Moulder--Packs the sand into the flask

Mixer --Breaks up the sand, mixes it, and pours it into the riddle

Sifter --Riddles the sand

Pourer --Assists the instructor in pouring the metal

Steps of Procedure (The pourer should read each step aloud and check off each step as it is completed.)

____ 1. Moulder places match plate on work surface with pattern-side up.

____ 2. Moulder locates drag (the half of the flask with the pins) on the match plate.

____ 3. Mixer puts sand in riddle as Sifter riddles sand onto the match plate until flask is filled.

____ 4. Moulder packs sand firmly as Mixer adds more sand.

____ 5. When drag is filled, Sifter levels sand with straight edge.

____ 6. Pourer places molding board over drag and helps Moulder invert flask.

____ 7. Mixer places cope (other half of flask) onto flat side of match plate.

____ 8. Sifter riddles sand into cope.

____ 9. Moulder packs sand as Mixer adds enough to fill cope.

____10. Sifter levels sand with straight edge.

____11. Moulder and Mixer carefully remove cope from match plate and set it aside.

____12. Sifter and Pourer carefully remove match plate from drag.

____13. Moulder and Mixer set drag up vertically and remove sprue and risers.

____14. Sifter and Pourer carefully assemble flask WITHOUT MATCH PLATE.

____15. Pourer and Sifter place flask into position to be poured.

____16. Pourer assists Instructor in pouring metal into flask.

____17. Allow metal time to cool.

____18. Moulder and Pourer should open flask and remove the casting.

____19. The excess metal will need to be cut away from the finished casting.

____20. Mixer should see that all sand is returned to its storage bin.

____21. Sifter should clean riddle and put it away.

____22. Moulder should clean and store the bench rammer, the match plate and the moulding board.

____23. Pourer should clean and store the flask.

Questions

1. What is the purpose of the sand in the sand casting process? ____________________________

2. Why must we use a specially prepared sand rather than ordinary river sand? ____________________

____

3. What is the purpose of the sprue? __________

____

4. What problems of safety are involved in sand casting? ____________________________

____

____

APPENDEX

SUGGESTIONS FOR THE TEACHER

1. In class discussion it would be helpful to have transparencies illustrating each of the forming techniques discussed.
2. Actual products which illustrate the forming process should be used in discussion.
3. If students are to do Activity III, it is suggested that the flask be constructed from wood in a small size so as to decrease the amount of foundry sand necessary for the activity and to make the flask light enough for easy handling.
4. An alternate means of providing an experience in casting would be to purchase permanent molds for making fishing weights and allow the students to cast lead sinkers.

BIBLIOGRAPHY

1. Forming Alcoa Aluminum, Aluminum Company of America, Pittsburg, Pennsylvania, 1962.
2. "Glass", Volumn 12, Encyclopedia Americana, Americana Corp., N. Y., N. Y., 1965.
3. "Plastic", Volumn 22, Encyclopedia Americana, Americana Corp., N. Y., N. Y., 1965.

ASSEMBLING

OBJECTIVES

1. The student, in studying this unit, should learn: How assembling fits into the manufacturing of products.
2. The student, in studying this unit, should learn: The importance of locating and orienting materials during the assembling of a product.
3. The student, in studying this unit, should learn: Why fastening is very important in the manufacturing of a product.

INTRODUCTION

The manufacturing processes can be broken down into three parts. (1) Primary processing, (2) Component processing, and (3) Assembling. We will be concerned with assembling. But, we will also study how the other two operations fits into the total operation of manufacturing.

Primary processing is the method of refining, converting, and bulk forming of raw materials to make a new material. For example, if we think of the manufacturing of steel. The iron ore has to be mined. The iron ore is refined to get pure iron. The pure iron is further refined to produce steel. This steel is rolled into sheet metal that can be used in the automobile industry. Other primary processed steel is made into "I" beams for structural steel in buildings, and wire for fences.

Component processing is the method of seperating, combining, and forming a product to be used in a larger product. Each of these component parts must be specially designed. They must be so standardized as to size and shape that they fit into place without previous trial. Some factories manufacture component parts only to be shipped to assembly plants throughout the country.

Assembling depends upon the other two operations of primary processing and component processing. Assembling can be done with just process material or by component process parts. If we look at a pair of roller skates, we can see there is a number of assembled parts. In the assembling of the skate the leather strap had to be refined and assembled. The metal body had to be assembled, and the wheels had to be assembled. The strap was fastened to the body with metal fasteners. Also, the body had to be positioned in a certain way so that the wheels could be assembled onto the body.

ASSEMBLING

When you remove the top from your ball point pen and put it back in the proper place, this is assembling. Assembling is defind as fitting together of parts to form a unit. You can look around you and see many things that have been assembled. Most objects have been assembled with all wood, all metal, a combination of wood and metal, or a combination of metal, wood, and plastic. Almost everything we use in our daily activities have been through some kind of assembly process.

Many of the products and parts made in factories must be assembled during various steps in the manufacturing process. For example, television sets, automobiles, and refrigerators are typical of the products which undergo many assembly operations. The workers who put together parts of finished products are known as assemblers.

Some assemblers, known as floor assemblers, put together large heavy machinery or equipment. These heavy products usually stand on the floor and often fasten together with bolts, screws, or rivets. Other known as bench assemblers, put together small parts to make subassemblies of small complete units, while working at a bench. Many assemblers work on products or parts which automatically pass their work stations on conveyors. The workers must do their assembly job within the time period it takes the part or product to pass their work station. This is known as an assembly line. The product was placed on a conveyor so that the worker can perform his operation.

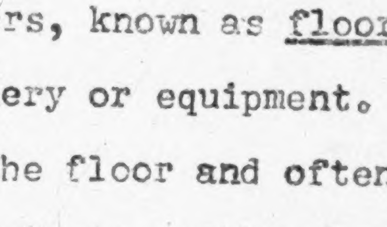


FIG. A. An assembly line of bread on a conveyor.

Positioning in assembling consist of turning or locating an object in such a way that it will be properly oriented to fit into the location for which it is intended. We can refer to the text book you have in your hand. Before this book was a finished product, many operations had to take place. After the printed pages were completed, they had to be positioned a certain way so that the covers could bind them together. The book parts whether bound by hand or machine had to be pre-positioned. Pre-position is to locate an object in a pre-determined place. Pre-position is the same as position, except that the object is located in the approximate position that will be needed later. Usually a holder, bracket, or container is used to hold the object. The object must be held in a certain position to permit the assembler to grasp it easely in the position in which it will be used. (Fig. B). If the stacks of paper aren't positioned the same, the assembler whould have to turn each stack before he could place them into the cover.

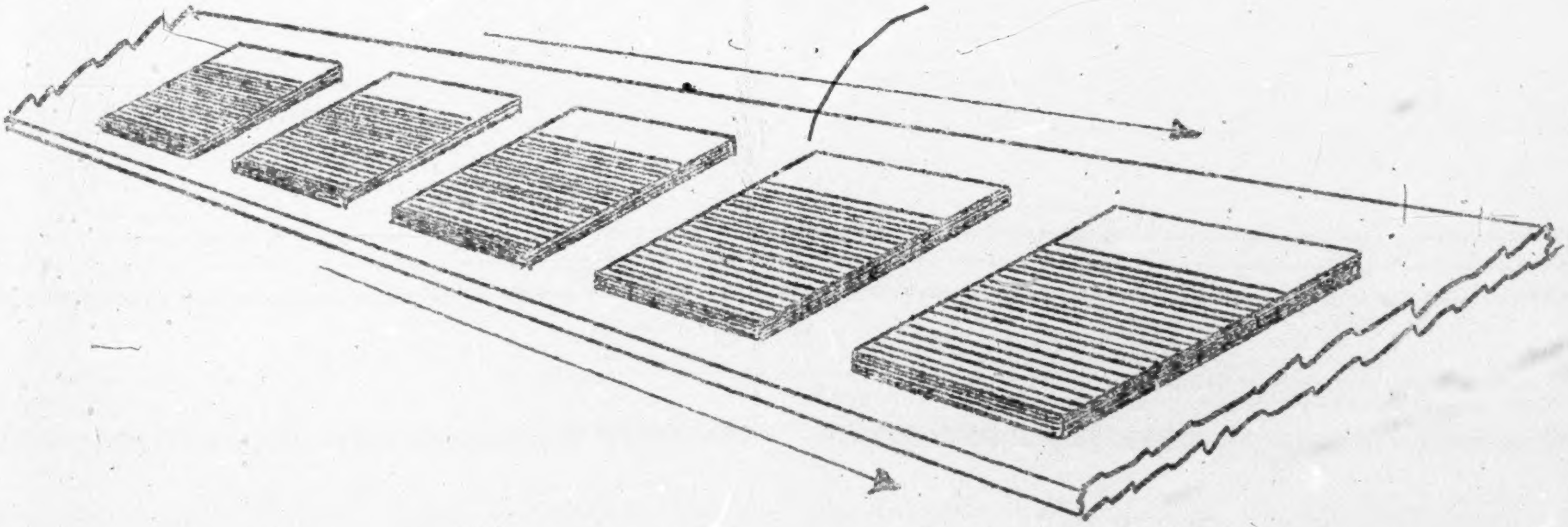


FIG. B. Positioning: Stacks of paper correctly positioned.

Fastening is the process of putting parts together to form a unit. We know that fastening can be done with two types of materials, (1) primary processed materials, or (2) component processed materials. There are many types of fastening devices and fastening products. They are used with one thing in mind. To fasten the component parts into a finished product, to serve the purpose for which it was intended. For example, we will consider a baseball glove. The manufacturer had to make a decision on what fastening procedure he would use to fasten the leather together. He had several choices, such as leather rivets, sewing with raw hide, bonding cement, clipping with stapers, or many other ways to fasten leather together. We know he used sewing for the glove body and lacing for the webbing. (Fig. C).

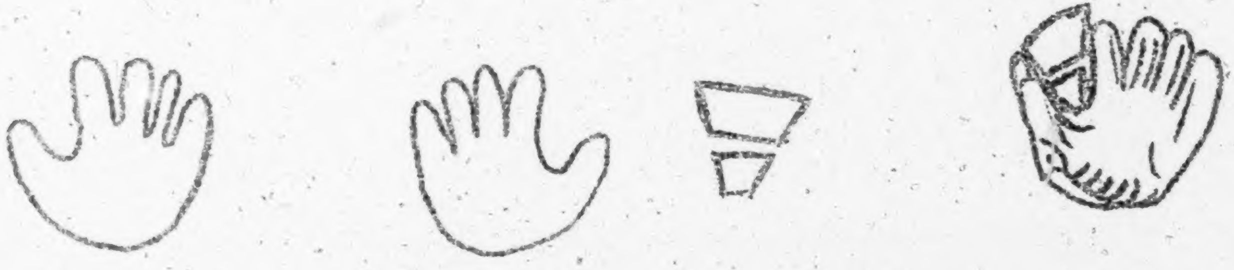


FIG. C. Fastening: Baseball gloves are sewn and laced.

When the baseball glove has become a finished product, it is shipped to wholesaler. A wholesaler buys products in large quantities, usually at a lower cost, from the manufacturer. The wholesaler sells the product to the retailer (store owner).

The retailers are small or large businesses who sell goods in small quantities, usually one at a time, to the consumer.

There had to be some type of crate or box used to ship the baseball gloves. We will assume that cardboard boxes were selected. The cardboard boxes had to go through some type of assembling and fastening. This might have been done by tapeing or bonding with cement. (Fig. D).

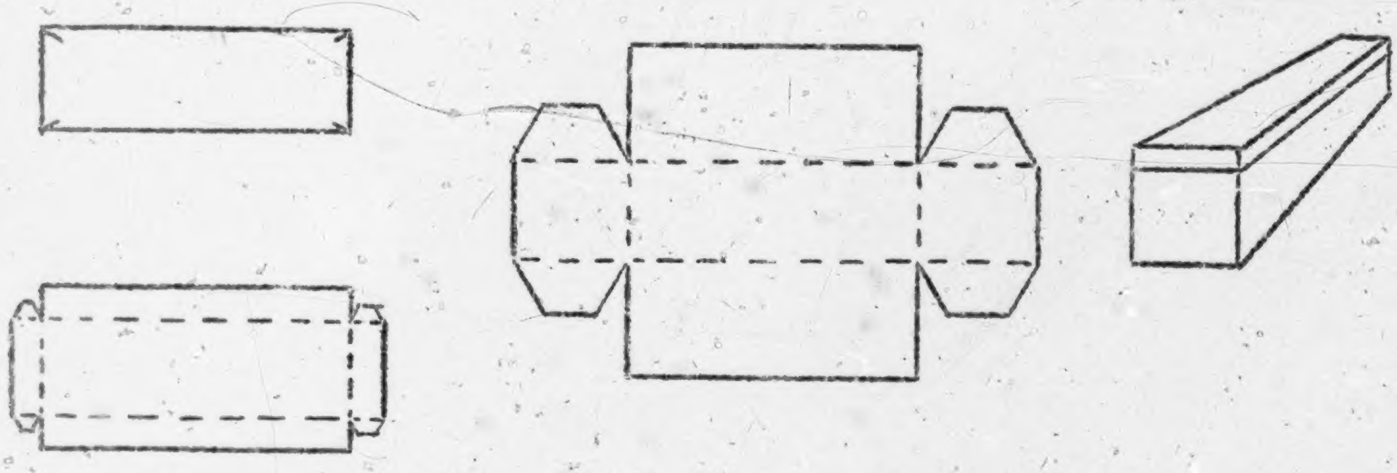


FIG. D. Layout and assembly of cardboard box.

The box would have to be a certain size. Therefore, the box had to be designed and produced to hold the baseball glove. We can see that there had to be many decisions made in assembling, before we can go and buy the baseball glove in the sporting goods store.

SUMMARY

We have seen that assembling is a very important process in the manufacturing of a product, You have seen that all manufactured products must go through a series of changes before it become a finished product. You should be able to examine a product and tell what process it went through to become a finished product. We should be able to tell what type of fastening was used. All products must go through primary processing, or component processing before the final assembly.

ACTIVITY

Objectives

1. The student will learn assembling, by using primary processed and component processed materials.

2. The student will learn the impontance of positioning, by assembling a wallet.

Wallet Assembly

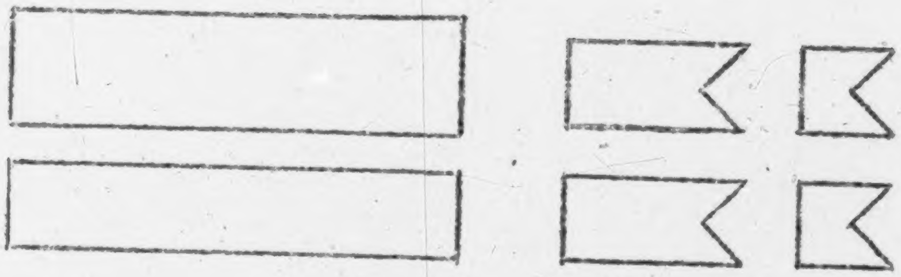
We are going to assemble a wallet to help you clearly understand the process of assembling. We will use five pieces of leather that have gone through the primary processes. They have also gone through the component processing, because they are cut to correct size and the lacing holes have been pre-punched.

Materials.

1. Leather kit (wallet with pre-punched holes)
2. Rubber cement
3. 15 yards of 3/32" goat lacing
4. Two prong lacing needle

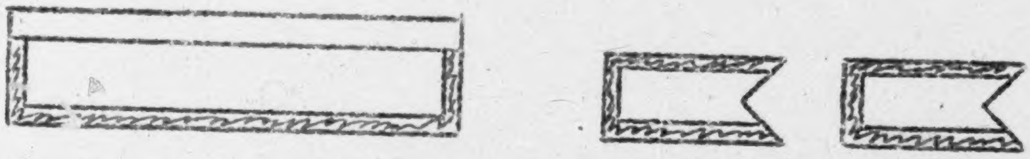
Procedures

1. Position the back and place the inner pocket and lining in the correct position, as shown below.

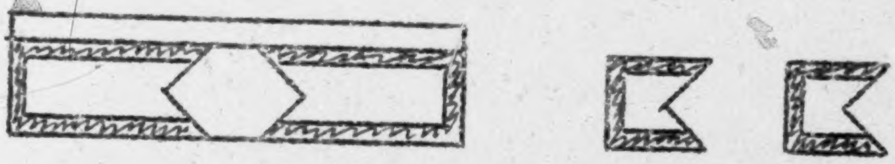


2. Apply rubber cement to edge of the inside of the back, and the inside of the lining. Allow to dry and press together.

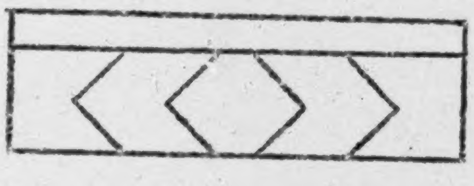
3. Apply rubber cement to outside of lining, and to the inside of large pockets. Allow to dry and press together.



4. Apply rubber cement to outside of large pockets and to the inside of small pockets. Allow to dry and press together.



5. Start lacing at the lower right of the wallet. We will use the whip stitch.



POST PROCESSING

Objectives

1. To be able to determine installing, maintaining, repairing, and altering as sub-elements of post-processing

2. To be able to determine the relationship between the life of the product and post-processing

3. To be able to discriminate between post-processing and other sub-elements

4. To be able to apply various post-processing sub-elements to practical learning experiences .

Introduction

The entire production process(preparing by making) is divided into three parts. These parts are:(1) pre-processing (2) processing (3) post-processing. Pre-processing is the recieving, unpacking, handling, storing, and protecting of a product. Processing is divided into three smaller parts. The smaller parts are:(1)primary processing(2)component processing(3)assembling. Primary processing produces(makes) the finished raw material(what the product is made of). Component(part) processing produces the parts of the product or the complete product. Assembling puts the product together into a complete product. As long as the product works it is useful. When the consumer(one who buys the product) needs any service for the product, post-processing is needed.

Post-Processing

Any work on a product after it is made is called post-processung.(figs. A,B,andC)

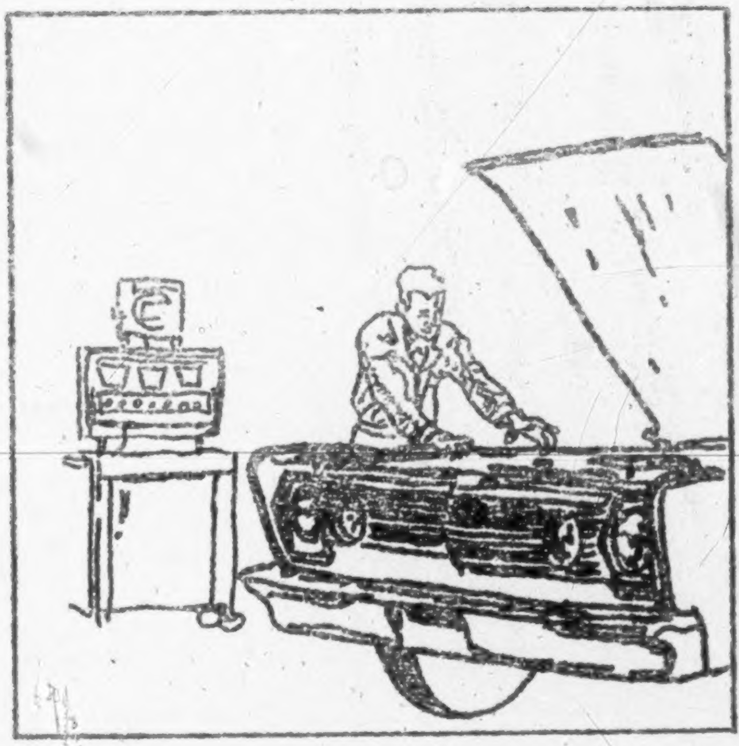
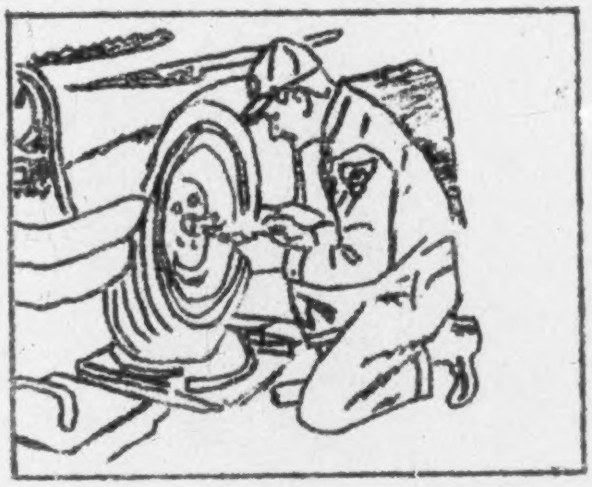


Fig. A Engine tune-up

Engine tune-up maintains the engine.

Fig. B Fixing a flat tire

Fixing a flat tire is repairing the tire.



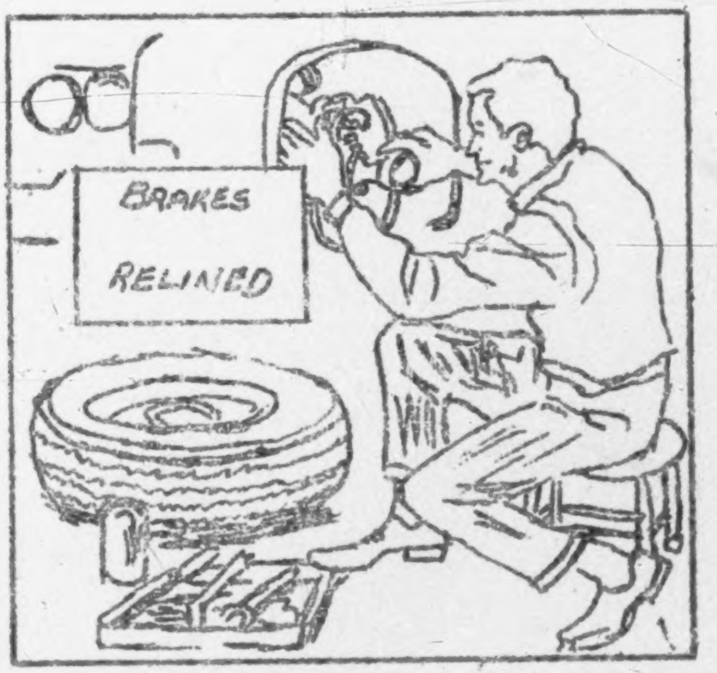


Fig. C Relining brakes

Changing brake shoes is altering. Attaching brake shoe is installing.

Installing, maintaining, repairing, and altering are the parts of post-processing. Post-processing gives a product a longer and more useful life. Sometimes a product is repaired or altered before it reaches the consumer. This is very costly to the manufacturer(one or ones who make the product). Most post-processing is done after the product has reached the consumer. Some examples are: (1) lubricating(greasing) a car (2) installing a gas range (3) changing a side-view mirror on a car (4) patching a bicycle tube. Perhaps post-processing may be thought of as servicing.

Installing

Installing a product means fixing a product or parts of a product into position for use. Many products need to be installed before they are useful to the consumer. A new bicycle pedal is useless(of no value) by itself. Connecting the pedal to a bicycle makes it useful. The pedal has been installed. Heaters, washers, and dryers are examples of completed products that need to be installed. There are many examples of parts of products that are installed to make complete products. Parts of a car, machine, radio, and television are examples of this.

Maintaining

Keeping up or keeping in use is the meaning of maintaining. Products, to be useful over a period of time, must be maintained. Proper amount of air in a bicycle tire or proper lubrication are examples of maintaining a product. Cleaning, waxing, checking, and testing are instances of maintaining a product. Maintaining makes the product last longer and work properly during its life.

Repairing

Repairing means preparing again or putting back in good condition. All man-made products wear out. Products wear out from age, use, or misuse(not used correctly). The tire on a bicycle is flat. It will not hold air. The tube is taken out of the tire. The tube is patched, tested, and put together again. This is repairing a product. There are many examples of repairing products.

Altering

Altering means changing. It is necessary frequently to change or alter a product. This is necessary to improve a product. For example, bicycles are not produced with a part to hold a registration(record of whom bicycle belongs) tag. Baltimore city requires a tag for all bicycles. Adding a frame to hold this tag alters the product. Some other examples of altering are recapping, refinishing, rebuilding, redecorating, and remodeling. Any product may be altered during its production or after its production.

Summary

Pre-processing, processing, and post-processing are units(parts of) production. Processing is the last production step before reaching the consumer. Any work done after the product has reached the consumer is called post-processing. Post-processing may be installing, maintaining, repairing, or altering the product or parts of the product. The useful life of the product depends upon post-processing.

Laboratory Activity

Objectives

1. To be able to identify installing by attaching a pedal to a bicycle

2. To be able to identify maintaining by checking the air pressure of the tires and lubricating the bicycle

3. To be able to identify repairing by patching the inner tube

4. To be able to identify altering by producing and attaching a tag holder to a bicycle

5. To be able to list five examples of installing, maintaining, repairing, and altering and be able to list at least sixteen out of twenty correctly

Materials

4 bicycle

4 (pcs) galvanized iron 3 1/2 x 6

2 tire repair kit

8 steel rivet

1 (can) flux

1 (roll) solder

2 ½pt anti-rust paint (red and blue)

Equipment

1 air hose
2 pressure gauge
1 grease gun
4 bicycle wrench
2 adjustable wrench(8")
1 tinners' snips
1 center punch
1 claw hammer
1 drill press
1 drill
1 countersink
1 riveting hammer
1 folding machine
1 bucking bar
1 soldering iron
1 soldering furnace
1 (bl) sal ammoniac
2 paint brush

A class of twelve students will be divided into four groups of threes. The groups will be named the "Alters", "Installs", "Repairs", and "Maintains". Each of the four bicycles has the following problems:(1)flat tire (2)need for a new pedal (3)need for a tag holder (4)need for lubrication.

The "Installs"group follows these steps:

1. Disassemble pedal from frame using bicycle wrenches
2. Attach new pedals and tighten nuts

The "Maintains"group follows these steps:

1. Find grease fittings on hub of wheel
2. Use grease gun over fittings and lubricate
3. Check front tire with pressure gauge

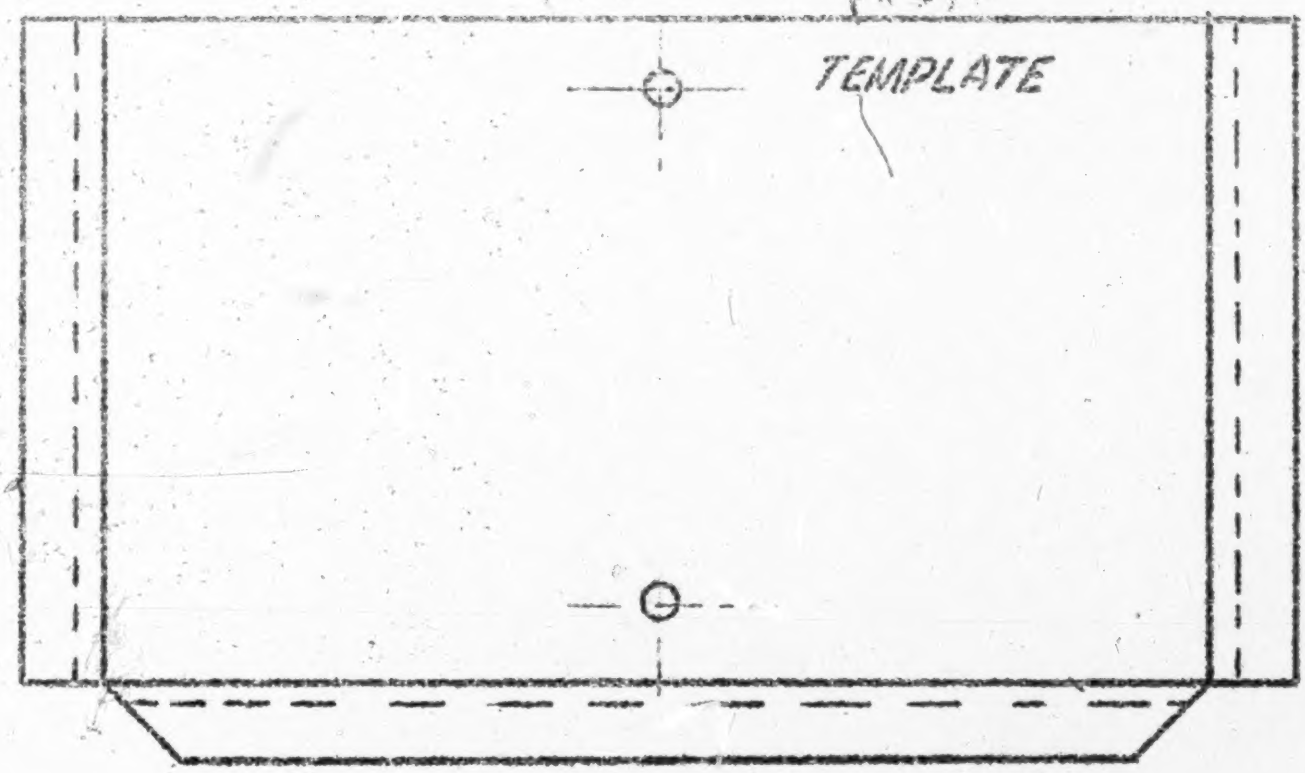
The "Repair"group follows these steps:

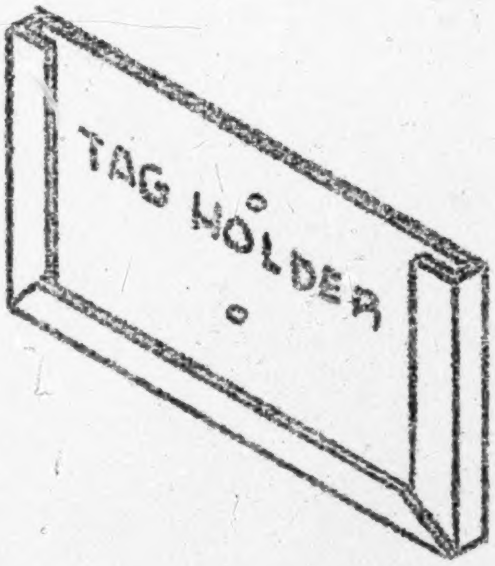
1. Pull tube from tire
2. Remove valve
3. Inflate tube holding air in with thumb

4. Turn tube in tub of water to find hole
5. Mark hole with chalk and release air
6. Scratch area around hole with roughing tool
7. Apply adhesive
8. Remove backing from patch and place over hole
9. Check for further leaks(steps 3 and 4)
10. Put tube in tire, placing valve stem properly
11. Insert valve
12. Inflate tube
13. Check with gauge for correct pressure
14. Assemble wheel to frame

The "Alters"group follows these steps:

1. Fold metal as shown
2. Locate and drill holes in holder(use template)
3. Locate and drill holes in fender(use template)
4. Sweat solder two bottom corners of holder
5. Paint holder(2 blue and 2 red)
6. Rivet holder to fender
7. Put second coat of paint on holder
8. Slide registration tag into holder


TEMPLATE


TAG HOLDER

ED 065731

industrial arts

ndea
institute
for
advanced
study

manufacturing

the ohio state university
1967

~~VT 015 791~~
VT 016 253

Instructional Materials

in

MANUFACTURING

for

Junior High School Industrial Arts

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION
THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL OFFICE OF EDUCATION POSITION OR POLICY.

Part II of IV

Product Synthesis A

Summer 1967

NDEA Institute for Advanced Study
in Industrial Arts
The Ohio State University
Columbus, Ohio
43210

Part II of IV

Product Synthesis A

Other Instructional Materials

In This Series

Generalized Manufacturing Technology
Regardless of Product Part I

Product Synthesis B Part III

Product Synthesis C Part IV

PREFACE

This synthesis unit in manufacturing was developed by eight participants of the 1967 Summer NDEA Institute for Advanced Study in Industrial Arts held at The Ohio State University. Two other product synthesis units similar to this one, together with the collection of units entitled "Generalized Manufacturing Technology Regardless of Product", complete the series of instructional materials developed during the eight week session.

Each group of eight men selected a product that could be manufactured in a junior high school industrial arts laboratory. They were encouraged to develop instructional materials that extended the structure of manufacturing technology as it had relevance for the product chosen. The materials have been written at approximately the 7th grade level of readability, and will be useful to teachers and pupils alike.

The general approach used by each group was common since the planned activities culminate in the operation of a managed production system in manufacturing. The means used in exemplifying this system, however, vary greatly. It is hoped that these units will spark the imagination of industrial arts teachers so that they will attempt new and better ways of interpreting the vast system of manufacturing to junior high school pupils.

Arthur W. Earl, Professor
Instructional Materials
Development workshop

INSTITUTE STAFF

Dr. Willis E. Ray, Professor of Education
The Ohio State University
Director of the Institute

Dr. Arthur W. Earl, Professor and Chairman
Department of Industrial Education and Technology
Montclair State College, Montclair, New Jersey
Instructional Materials Development

Dr. Donald R. Kibbey, Assistant Professor of
Industrial Engineering
The Ohio State University
Advanced Manufacturing Management, Personnel and
Production Technology

Dr. Donald G. Lux, Professor of Education
The Ohio State University
Advanced Industrial Arts Curriculum

Arthur J. Rosser, Doctoral student in
Industrial Arts
The Ohio State University
Administrative Assistant

John Butala, Jr., Doctoral student in
Industrial Arts
The Ohio State University
Instructional Assistant

Phillip A. Fazzini, Doctoral student in
Industrial Arts
The Ohio State University
Instructional Assistant

Miss Grace M. Twine--Secretary

CONTRIBUTORS

Product Synthesis A

John H. Barnhill
Budd Junior High School
Loudonville, Ohio 44864

Ernest D. Cadwell
Apollo High School
Apollo, Pennsylvania 15613

John F. Collins
Barnum Junior High School
Birmingham, Michigan 48003

Terry L. Davis
Emerson Junior High School
Lakewood, Ohio 44107

Louis J. Eckhardt
Roy W. Brown Junior High
Bergenfield, New Jersey 07621

David N. Kelsey
Randolph Southern Junior High
Lynn, Indiana 47355

Harry S. Langman
Westview Junior High School
Miami, Florida 33167

Andrew J. Nadzam
Board of Education
Youngstown, Ohio 44503

TABLE OF CONTENTS

Introduction 1:1

Management Planning 2:1

Design - Phase I 3:1

Design - Phase II 4:1

Engineering 5:1

Personnel 6:1

Purchasing 7:1

Sales and Distribution 8:1

Summary 9:1

Transition Notes 10:1

Concluding Statement 11:1

Appendices 12:1

List of Appendices vii

LIST OF APPENDICES

APPENDIX

A - Design A 12: 1

B - Design B 12: 2

C - Design C 12: 3

D - Design D 12: 4

E - Job Specification Form 12: 5

F - Employment Application Form 12: 6

G - Plant Layout 12: 7

H - Flow Chart 12: 8

I - Procedure Sheet 12: 9

J - Pictorial of Adjustable Book Holder 12:11

K - Drawing of Adjustable Book Holder End 12:12

L - Drawing of Adjustable Book Holder Slat 12:13

M - Drawing of Miter Box Jig No. 1 12:14

N - Drawing of Miter Box Jig No. 2 12:15

O - Drawing of Miter Box Jig No. 3 12:16

P - Drilling and Marking Jig No. 1 12:17

Q - Drilling and Marking Jig No. 2 12:18

R - Examination and Key 12:19

INTRODUCTION

This unit provides the instructor with material for an introductory product synthesis activity in Manufacturing Technology based on the daily units which were presented in the first part of the course. It is designed to create a workable classroom situation in which every student is involved all the time either as an active participant or an analytical observer. The student will be assisted, through the technique of roleplaying, to relate the management to the production functions of Manufacturing Technology.

Roleplaying has been recognized as a powerful developmental tool in bringing about behavioral changes* It is suggested here as methodology appropriate to the age and progress of seventh grade students. It is further suggested that as students become more adept, future synthesizing activities be less structured. The roleplaying would then

* Two helpful references are:

1. Raymond J. Corsini, Malcolm E. Shaw, and Robert R. Blake, Roleplaying in Business and Industry, The Free Press of Glencoe, Inc., 1961

2. Mildred Nichols and Lois Williams, Learning About Roleplaying for Children and Teachers, Association for Childhood Educational International, 3615 Wisconsin Avenue, N. W., Washington, D. C.

contain a greater degree of spontaniety and imaginativeness, and creative planning on the part of the student would be encouraged.

The beginning Industrial Arts class has been provided with a series of daily lessons aimed at imparting a body of knowledge conceptually conceived and broadly generalized. Each reading assignment is implemented with a specific laboratory activity intended to develope insights and basic skills in the area of Manufacturing Technology. With the purpose of unifying these concepts and skills into a well integrated and meaningful whole, the following synthesis is proposed:

1. After hearing an appropriate introduction by the instructor, the students will be provided with dialogues portraying typical situations on the managerial level of the manufacturing industry. Each dialogue will contain the roles played by management personnel and others for such areas of manufacturing as management planning, product design, engineering, personnel, etc.

2. At the instructor's discretion, role assignments may be made or volunteered. The dialogues will then be read along with the use of appropriate "props" such as sketches, specifications, drawings, employment application forms, flow charts, etc. During the reading of the dialogues the remainder of the class will participate as audience observers. Following each dialogue, a brief discussion will be held to answer questions, exchange ideas,

and make suggestions.

3. The roleplaying will continue to the point of actual production, at which time tool operations and process flow will be demonstrated. Then, specific production line assignments will be made and the students will participate in the input-process-output sustem of a managed production line.

It is felt that the importance of this approach lies in its ability to provide the instructor with a technique that:

1. Synthesizes the big ideas of manufacturing technology in a comparatively brief block of time. The suggested time allotment is 2-3 periods for management planning and 2-3 periods for production.

2. Helps the instructor keep all his students involved, minimizing the chance of idleness leading to discipline problems.

3. Acts as a natural stepping stone to future in-depth synthesizing activities as the student matures.

SPECIAL NOTE: It is important to remember that roleplaying in the Industrial Arts classroom is meant as an educative device, not a literary art form. The dialogue format is intended to establish in the student's thinking the idea that manegerial activities are vital to modern industry, and that managers think, talk, and plan together prior to the actual production of a consumer product. It is hoped that this approach will be regarded as merely one way to encourage creative thinking on the part of Industrial Arts teachers, enabling them to break away from the present limited teaching of tool skills and project making. Especially important is the wise use of questions and answers at the end of each dialogue to involve the students in active critical analysis of the ideas being taught.

MANAGEMENT PLANNING

OBJECTIVES

After reading this dialogue, the student should be able to understand:

1. How changing human needs bring about decisions to manufacture new consumer products.
2. How the techniques of the market survey and analysis help the manufactured determine the needs of the buying public.

SITUATION: Company management meeting to discuss a new product.

SETTING: Office of the company president.

CHARACTERS: President of the company - Mr. Woods
Market research manager - Mr. Jacobs
Design manager - Jim

PRESIDENT: Gentlemen, we are here today to receive the market analyst's report. Mr. Jacobs is our Market Manager and head market research analyst. Mr. Jacobs, will you please make your report.

MARKET MANAGER: According to our most recent survey, while book sales to schools have increased, the sale of large bookcases has fallen off. The reason for this lies in the fact that more teachers than ever before are ordering small sets of reference texts to be used in their own classrooms.

PRESIDENT: Why is this? I thought that most reference books were ordered by school librarians and never left the library.

MARKET MANAGER: Under Title III of the National Defense Education Act, more money is now available to classroom teachers for ordering books. The teachers are really taking advantage of this opportuniy to make each classroom a self contained research center. Which brings us to the core of the problem.

PRESIDENT: What is that?

MARKET MANAGER: The need for a sturdy, portable bookholder. One that can be used by teachers in their own classrooms. The survey seems to indicate that an adjustable bookholder may have greater sales appeal. (to the designer) Will you and your staff be able to design a bookholder of this description?

DESIGN MANAGER: I think I understand the problem, and I am sure we will be able to come up with something to answer your needs. When would you like to see my preliminary sketches?

PRESIDENT: Will Friday be too soon?

DESIGN MANAGER: No sir, I think that will give me more than enough time.

PRESIDENT: Good, I'll have my secretary keep ten o'clock open on Friday morning. And, by the way, I'll arrange to have our chief engineer and also our production manager and purchasing agent there to exchange ideas.

QUESTIONS FOR DISCUSSION

1. What was the purpose of the meeting?
2. Who was present at the meeting, and what is each one's function?
3. What analytiwal device was used to determine the need for bookholders?
4. What are the four basic characteristics of the bookholder that will have to be considered by the designer?
5. Who do you think will decide which design most nearly fills the requirements?

FILMED FROM BEST AVAILABLE COPY

would open a vast new sales area.

DESIGNER B: Are we limited to the type of materials that we can use for component parts?

MANAGER: Yes, we're going to limit the material to wood since our cabinet shop is working on a limited production schedule and this book holder would enable us to utilize the shop to its maximum production output.

DESIGNER A: What other specifications must we consider?

MANAGER: The book holder will be approximately 18" long. It will hold average size books which are 7" wide and 9½" long. Engineering will determine the final sizes and other specifications.

DESIGNER B: Why don't we make it adjustable. It seems that an adjustable book holder would have more sales appeal.

MANAGER: That's a good point. This was suggested in the market survey. Let's consider both types.

DESIGNER A: What price range should we be concerned with?

MANAGER: We would like to have a retail price of $2.25.

DESIGNER B: We should be able to hold to that figure since we have a large variety of woods to choose from at a wide range of cost.

MANAGER: Yes, we do have a number of choices, but this brings up another factor. These book holders will not be painted so the wood grain becomes an important part of the design. Again, engineering will influence the final choice of the wood.

DESIGNER A: Are we going to offer a variety of finishes?

MANAGER: Possibly, but the choice will more than likely be a one step finish with a variety of color choices.

DESIGNER B: When do we get started?

MANAGER: Let's try to have the sketches ready in two days. I have arranged a conference with the Product Engineer and Production Manager to determine which of our designs will be within our production capability.

QUESTIONS FOR DISCUSSION

1. What are some of the factors which influence the design of a product?
2. What important features should the book holder design include?
3. What is a "competitive model?"
4. Sketch a few designs of a book holder as you think it should be manufactured.

DESIGN - PHASE II

OBJECTIVES

As a result of reading this dialogue, you will be able to:

1. Define the job of the designer.
2. Identify the function of the production manager as it relates to the product design.
3. Identify the function of the product engineer as it relates to the product design.
4. Make decisions while selecting a product design.

SITUATION: Design manager in conference with the production manager and the product engineer.

SETTING: Office of the production manager.

CHARACTERS: Design Manager - Jim
Production Manager - Greg
Product Engineer - Art

ILLUSTRATIVE MATERIAL: Design Sketches

DESIGN MGR.: My department has developed four possible designs for the new book holder. We must now decide which one may be produced to meet the $2.25 retail price. Remember that the market analyst indicated that an adjustable unit may have greater sales appeal. You will notice that these designs represent both adjustable and non-adjustable types.

PROD. MGR.: How many are we going to produce?

DESIGN MGR.: That's a good starter. I discussed this point with the market analyst and the president the other day. It was decided that we should start production with about 100 units. If the book holder sells well, we will step up production, hopefully to meet the public demand.

PRODUCT MGR.: Then the design should be simple and easy to construct. Let's keep the cost to a minimum by using as few jigs and fixtures as possible.

DESIGN MGR.: Yes. I guess we should.

PROD. MGR.: Tell me something. When you designed these book holders, were you more concerned with function than with appearance?

DESIGN MGR.: In large part, yes. Although appearance was not ignored as a requirement for sales appeal, we realized that a better appearing item would increase the production cost. You will notice that design A (Appendix A) with its pencil and letter holders and design C, (Appendix C) a colonial style, do emphasize appearance to some degree. These may present production problems.

PROD. MGR.: Yes. I think so. Art, would you review the possible problems?

PRODUCT ENGR.: Certainly. These two designs do have a greater eye appeal. However, the cost for production would be higher. The tongue and groove that makes design A (Appendix A) adjustable would alone require a higher retail price than we are shooting for. The number of fixtures required would also increase the cost. The cost for materials would not be too great, but the operations required to produce all the parts would be out of our price range.

DESIGN MGR.: Are you suggesting that we over designed this one, especially with the compartments at the ends?

PRODUCT ENGR.: For our requirements, yes. The tooling, fixtures, and production time all contribute to a higher selling cost. Even if we were to produce a greater number using specalized tooling, the consumer cost could not be held to $1.25.

PROD. MGR.: It appears that our goals cannot be met with this design. Shall we agree to eliminate this possibility?

PRODUCT ENGR.: Yes. I agree.

DESIGN MGR.: There is no question. We must eliminate this design. Art, let's continue with design C. (Appendix C)

PRODUCT ENGR.: All right. This colonial design meets all the qualifications for good design. It has line quality and a shape which appeals to the eye of one who likes this style. It would do the job of holding books, and woo seems to be theright material. The joints and fancy cuts, however, would not permit a 2.25 retail price.

PROD. MGR.: Did the market analyst indicate what style might be most accepted?

DESIGN MGR.: No. He did not. That's why we came up with a few different styles. It appears that we are going to have to stick to more simple designs.

PROD. MGR.: I guess so. Although I rather like this design.

PRODUCT ENGR.: I think the price restriction has clamped the lid on this one.

DESIGN MGR.: Ok, let's consider the other two designs: designs B and D. (appendix B & D)

PRODUCT ENGR.: Design B (appendix B) ~~may~~ not be the best looking in the world, but it certainly could be produced easily. There would be no problem meeting the cost requirement.

PROD. MGR.: It sounds as though this design meets our needs fairly well. Jim, do you think it would be wise to accept this design?

DESIGN MGR.: Not at the moment. After all we agree that it is not the best looking. We still have one more to consider. I am not sure that I can get excited about this one.

PROD. MGR.: Design D (Appendix D) wouldn't be an adjustable bookholder.

PRODUCT ENGR.: This is true. Special equipment would also be needed for the square slots in the ends. This would increase the cost for this short run. The material costs would be about the same as for design B. (Appendix B)

PROD. MGR.: I think we should decide whether the adjustable feature should be a part of the design.

DESIGN MGR.: This would help us to make a decision. I think that an adjustable feature would be of value. It would eliminate the problem of books leaning when there are only a few in the holder.

PRODUCT ENGR.: I agree. But, I am not sure about the appearance of design B. (Appendix B) Jim, is there any chance that your department could develop a few more designs?

DESIGN MGR.: Not a chance. We only had two days and this is the end of the second day.

PROD. MGR.: Then design B is it.

PRODUCT ENGR.: I guess this is the solution. Jim, how soon can you get the final design sketch to the engineering department.

DESIGN MGR.: Well let's see, I'll have to have it prepared and get it approved by the president. I supose a day and a half should get it there.

PROD. MGR.: Very good. We will do the necessary planning from our end. Good luck.

QUESTIONS FOR DISCUSSION:

1. What department within the company made the design sketches?
2. Why should the production manager be concerned with the product design?
3. Why should the product engineer be concerned with the product design?
4. What conditions required that the selected design be simple and easy to construct?
5. Why was it decided to start production with only 100 units?
6. What is meant by a short run?
7. Was the designer more concerned with function or appearance?
8. Under what conditions would the designer be more concerned with appearance?
9. What is meant by over-designing?
10. Why was design B selected?
11. Why does the engineering department need the design sketch?

ENGINEERING

OBJECTIVES

After reading this dialogue, the student should be able to:

1. Understand various kinds of engineering problems and why engineering is needed.
2. Give examples of how engineering decisions could change the design of a product.
3. Explain what jigs are and for what purpose they are used.
4. Peform elementary engineering activities.

SITUATION: Chief Engineer consulting with his staff. They are planning for production following the designing activity.

SETTING: Engineering conference room

CHARACTERS: Mr. Sloan - Chief Engineer

Bill - Engineering Draftsman

Sam - Tool Designer & Draftsman

Yogi - Production Manager

ILLUSTRATIVE MATERIAL: Appendix B, E, G, and H

CHIEF ENGINEER: Mr. Sloan You have had two days to study the sketches, and I know that you are anxious to see this product get into production. (Appendix B). The president seemed very pleased with the final design. We've been given the go-ahead to work out details, tooling, inspection, and preparation for production.

Bill, what were you able to find out about our parts fitting stock sizes?

ENGINEERING DRAFTSMAN: Bill I've checked with purchasing on standard stock sizes. To use standard sizes, we will need to cut slat width down to 2 inches and hold the end height to 6½ inches if we are going to avoid waste. Production prefers to use the standard 1" x 8" x 12' lumber size since this is the limit for our storage and handling equipment.

CHIEF ENGINEER: Mr. Sloan Will the thing still hold books using these dimensions?

ENGINEERING DRAFTSMAN: Bill Yes sir. By changing the slot angle slightly, we found that stability was actually improved.

CHIEF ENGINEER: Mr. Sloan Good. We'll use the prints just the way you have them now unless something new comes up.

I've given some thought to what kind of wood to use and it looks like we should use an inexpensive hardwood or softwood.

PRODUCTION MANAGER: Yogi It sure would be nice if we could use walnut or mahogany.

CHIEF ENGINEER: Mr. Sloan Cost alone rules those out. It's hard enough to compete when we use those expensive woods on our very top quality items. Purchasing suggests that we can get black willow or white pine for about the same price.

PRODUCTION MANAGER: Yogi Let's take the black willow. It is easily worked and takes a beautiful finish. The pine tends to have more knots and sometimes gives us trouble with cracking.

CHIEF ENGINEER: Mr. Sloan Give purchasing the O. K. to order the stock for the first months production.

How are we doing for plant space, Yogi? You mentioned yesterday that your south line would be available.

PRODUCTION MANAGER: Yogi I believe the south line can be ready to run next week. Some machines need to be moved around to improve production flow. (Appendix H). This chart shows the flow line as it will be when we start production. I've got some men cleaning out those storage areas and painting the place up a bit. (Appendix G).

CHIEF ENGINEER: Mr. Sloan Can we get a miter machine for this job?

PRODUCTION MANAGER: Yogi Yes. We've just had the Armstrong High Speed Miter Box rebuilt. It's already installed and should be a real boost to production time.

CHIEF ENGINEER: Mr. Sloan Fine! How are you fixed for manpower?

PRODUCTION MANAGER: Yogi Pretty good. I do need a couple of skilled saw and drill operators. I've notified personnel, but they want your approval. Tell them I don't want any women this time! The last ones were a problem with their hair nets and safety glasses.

CHIEF ENGINEER: Mr. Sloan

You may have ~~to take~~ what you get; but, don't tolerate safety violations! We've had a good record here and we want to keep it that way.

Sam, what about tooling?

TOOL DESIGNER: Sam

No serious problems. The end pieces will require 3 sawing jigs. We can re-use an adjustable jig from another job for the drilling. The standard hardware and stops will be all that we need for the high speed miter box.

CHIEF ENGINEER: Mr. Sloan

What has been done about quality control?

TOOL DESIGNER: Sam

Wilber, our head toolmaker, suggests that we gage those slots to maintain a sliding fit. The other dimensions arent too critical. (Appendix E).

CHIEF ENGINEER: Mr. Sloan

I'll approve the order for those jigs and the gage. If your drawings check out with Bill's new dimensions, go ahead and have the tool room get started.

TOOL DESIGNER: Sam.

O. K., I'll make all the arrangements.

PRODUCTION MANAGER: Yogi

Say Mr. Sloan, how are we running the finishes on this job?

CHIEF ENGINEER: Mr. Sloan

Design calls for our same Minwax finish. We'll work the book rack line right in with our other product lines.

PRODUCTION MANAGER: Yogi
Fine.

CHIEF ENGINEER: Mr. Sloan
O. K. men. I want you to get out a few prototypes as soon as possible. Research will need a couple for their tests and we want some to take to the next management meeting. Let me know if you have any problems.

QUESTIONS FOR DISCUSSION

1. What are some of the reasons that engineering might need to change the design of a product?
2. What kind of jobs are of concern to the chief engineer?
3. What is meant by production flow?
4. Why was the chief engineer concerned about safety?
5. What is meant by tooling? gage? Jig?
6. What is quality control and why do manufacturing industries use it?
7. what is a prototype?
8. Why would a manufacturing industry test their products before production begins?

PERSONNEL

OBJECTIVE

After reading this dialoque, the student should be able to identify procedures for:

1. Job analysis.
2. Interviewing job applicants.

SITUATION: Mr. Smith, personnel director, is talking to Mr. Jones, production engineer, in regards to the number of people to be hired for the bookholder production.

SETTING: Mr. Jones's conference room.

CHARACTERS: Production Engineer - Mr. Art Jones
Personnel Director - Mr. Sam Smith
Applicant - Mr. Know-how

ILLUSTRATIVE MATERIAL: Job Specification Form (Appendix E).
Employment Application (Appendix F).

PERSONNEL DIRECTOR: Art, how is the job analysis phase of the program coming along? Did your boys finally determine the production phase of this bookholder?

PRODUCTION ENGINEER: Yes, Sam. We determined the production flow of the bookholder. We need men for the following jobs:

(1) personnel man
(1) foreman
(4) sanders
(2) finishers
(2) assemblers
(3) inspectors
(4) backsaw operators
(2) drill press operators
(2) jig saw operators

PERSONNEL DIRECTOR: Good, Art. I'll have one of the boys write up the job specs. (Appendix B). When we're done, I'll run them over to you for a final check.

PRODUCTION ENGINEER: Right, Sam. See you this afternoon with the data.

SITUATION: Mr. Smith is interviewing Mr. Know-how, who is applying for the drill press operator's job.

PERSONNEL DIRECTOR: Good morning, Mr. Know-how. How are you this morning?

APPLICANT: Fine, just fine, thank you.

PERSONNEL DIRECTOR: I see that you worked the past two years for the Westing Motor and Compressor Company as a drill press operator. This is good. I also see that you did well on the dexterity test. I am sure we can use a man of your ability.

APPLICANT: Good. How much does the job pay?

PERSONNEL DIRECTOR: The job pays $2.50 an hour for the first six monnths. You then receive $2.75 per hour for the next six months. The third step will be $3.00 per hour. Previous experience is not allowable to place you on the third step, but it is a deciding factor for hiring you. Union regulations, you know, won't permit us to start you higher on the scale.

APPLICANT: Well, your fringe benefits are pretty good. I guess that will make up for it. A recess every two hours, clean work areas, your intramural program and insurance benefits will satisfy my needs. I'll take the job.

PERSONNEL DIRECTOR: Well, we have to get you a physical examination first. If you pass the examination, you have the job. We'll notify you.

APPLICANT: Well, its been nice talking to you Mr. Smith. Good-bye.

PERSONNEL DIRECTOR: Good-bye, Mr. Know-how. Hope to see you around the production line, drilling holes.

QUESTIONS FOR DISCUSSION

1. Which person decides the exact number and types of jobs required for production of a product?

2. (a) What is a job specification? (b) How will a job spec. help the personnel man in hiring an applicant? (c) Suggest some specs. for sawers, assemblers, sanders, and finishers?

3. How did the personnel director know that the applicant worked two years at Westing Motor and Compressor Company? What should the director do to be sure of this fact?

4. What is the meaning of fringe benefits?

5. Will Mr. Smith really see Mr. Know-how on the production line? Explain?

PURCHASING

OBJECTIVES: After reading this dialogue, the student should be able to:

1. Understand some of the problems concerned with securing materials necessary for the production of an item.
2. Understand the need for step by step planning flow - design, engineering and purchasing.
3. Define some concepts related to the problem of securing material.

SITUATION: Conference to decide questions concerning material to be ordered.

SETTING: Purchasing Agent's Office.

CHARACTERS: Purchasing Agent - Mr. Mackley.
Buyer - Mr. Schultz

ILLUSTRATIVE MATERIAL: Engineering Specifications, Appendix J, page 12-10, Appendix K, page 12-11, and Appendix L, page 12-12.

PURCHASING AGENT: Engineering has sent over the specifications for our next production item - the bookholder. We have to order all necessary material.

BUYER: I see that it is made of black willow. Are stock sizes called for?

PURCHASING AGENT: Yes, we are to select common stock sizes wherever possible so that the production cost stays down.

BUYER: This production order calls for a run of 100 pieces.

Are we going to over-order by 10% as usual?

PURCHASING AGENT: Yes, we'll follow our standard procedure. Let's try another supplier. That lumber we got from the Split-Knot Company wasn't quite as good as it should have been. We had too much waste.

BUYER: Just what are we responsible for ordering?

PURCHASING AGENT: According to these specifications, we will need material for the ends, the slats and the finishing material.

BUYER: What about size?

PURCHASING AGENT: The Production Manager notified us that the ripping machine is out of commission. That means the slat material will be ordered already cut to thickness and length.

BUYER: Since we need so many end pieces, we should be able to get the lumber mill to cut them to size at no extra charge.

PURCHASING AGENT: We still have to consider abrasives and finishing materials.

BUYER: The warehouse records show that we have plenty of 2/0 paper. The inventory of Minwax finish is also in good shape.

PURCHASING AGENT: We have it settled as to the material we need for the bookholder. I want you to order the items immediately. We are to be ready to go in one week.

BUYER: I'll start on it right away.

QUESTIONS FOR DISCUSSION:

1. Why must the purchasing agent wait for engineering specifications before he can have material ordered?
2. Why is it important to consider standard or stock sizes when producing something?
3. What could have been wrong with the lumber from the Split-Knot Company?
4. What is meant by "inventory"?
5. Why would a lumber mill cut pieces to a specific size?
6. Why would more material be ordered than was needed for 100 bookholders?
7. Why must the purchasing department be notified long before production is to begin?

SALES AND DISTRIBUTION

OBJECTIVES

The student shall develop an understanding of the following:

1. Who makes management decisions with respect to sale and distribution of a product.
2. What are the basic decisions which must be made prior to the sale and distribution of a product.

SITUATION: The General Sales Manager is meeting with the head of the Marketing Department.

SETTING: Marketing Manager's office.

CHARACTERS: Al Jacobs, Marketing Manager.
John Sloan, Sales Manager (head of all the sales staff).

MARKETING: (Al) You probably know why I called this meeting, John. It's to get the ball rolling on the Adjustable Book Holder.

SALES: (John) Yes, I figured that was it. How soon will production begin?

MARKETING: (Al) Well, Actually production has already begun. If everything goes according to schedule the first Book Holders will be coming off the line the first of next week.

SALES: (John) This really doesn't give us much time then does it?

MARKETING: (Al) No, but things are really pretty well planned. Our Advertising Department tells me that the magazine advertisments are already on their way. They should be appearing in the next issue of several national magazines. The Department is also preparing a little brochure which will be mailed to potential customers.

SALES AND DISTRIBUTION

SALES: (John) Just who are these potential customers?

MARKETING: (Al) That's the value of market research, John. It tells us where the market is and how big we can expect the market to be. We are not in the dark on this thing. Our report indicated that by far the largest market for the Book Holder would be the public school systems. There is also a pretty good market with the public libraries.

SALES: (John) Good. You know the beauty of this is that wherever the public schools are located the public libraries are also nearby. By having more or less of a concentrated market my department can cut costs considerably.

MARKETING: (Al) We, in the Marketing Department, thought it would be wise to begin sales in a three state area. By beginning this way we feel we can improve the whole marketing program before the bulk of the money is invested.

SALES: (John) This sounds like good business. It will also give my department time to recruit and train new people. We will need some new people when the sales program is expanded.

MARKETING: (Al) I'm glad you agree.

SALES: (John) My sales people will need some type of sales information. Perhaps a sales kit and a sample of the Book Holder.

MARKETING: (Al) Right. Make out a tenative list of what you feel the kit should include and how many you will need.

SALES: (John) What will be the procedure on delivery of the Book Holder? Can we promise immediate delivery?

SALES AND DISTRIBUTION

MARKETING: (Al) Unless we run into an unusually large order, or a rush order, I see no reason why we can't make delivery within ten days. We can meet that kind of a schedule using our own trucks. Of course, this is the cheapest way to ship also. In case of a rush order we will just have to ship by faster means and add the cost to the customer's bill.

SALES: (John) Just one final question. We, in the Sales Department, would like to get the Book Holder off with a boom. I would like to use some sort of incentive system to give my salesmen alittle something extra to work for. Do you think some sort of contest would be out of line?

MARKETING: (Al) It sounds like a good idea but you know I couldn't approve anything like that without first talking to the President. If the cost of this contest can be added to the cost of the product, I think he might appove the idea. I'll see him today and discuss it with him.

SALES: (John) Okay, good enough. I'll be in touch within a day or so.

MARKETING: (Al) Right, if you have any problems or questions don't hesitate to give me a call.

QUESTIONS FOR DISCUSSION

1. What information in the market survey analysis is important to the Sales Department?

2. Who normally will handle the advertising necessary to the sale of a product?

SALES AND DISTRIBUTION

3. Who really pays for contests, gimmicks, or other types of incentive systems?

4. When might special methods of distribution of a product be called for?

5. Does a department have the right to make decisions on money matters without consulting people higher up in the organization?

SUMMARY

The foregoing dialogues included typical management segments of the manufacturing industry. While wide variations exist in specific manufacturing plants ranging from industrial giants such as the automobile industry to small job shop operations, it will be found that the functions of management are generally the same. They may manifest themselves through the activities of a single owner in a small factory or through the complex line and staff organizations of vast corporate enterprises.

The areas of Manufacturing Management included in this unit are:

1. Management Planning
2. Product Design
3. Product Engineering
4. Process Engineering
5. Personnel
6. Purchasing
7. Production
8. Marketing and Sales

TRANSITION NOTES

INTRODUCTION

Once the students have completed the roleplaying section of the synthesis, preparation for production should begin. To stay within the spirit of the synthesis, however, the teacher cannot simply put students at the various work stations and begin work. The teacher must, as much as is possible, continue with the idea that an attempt is being made to recreate the managed production system. The gap which separates roleplaying from actual production is no small one. What follows are some assumptions and suggestions to aid the teacher in planning this critical part of his program.

BASIC ASSUMPTIONS

The following are assumptions basic to the planning of the materials to be used in making the transition:

1. All students have studied the general units on manufacturing.
2. All students have participated in the roleplaying and the discussions which followed.
3. The teacher will have prepared all necessary jigs, fixtures, templates, and other materials required to begin production.
4. The teacher is attempting to represent manufacturing practices as much as is possible.
5. The teacher will consider this outline, but only as one of many possible approaches.

SUGGESTIONS TO THE TEACHER

Consider the following:

1. Each student might be provided with a copy of the plant layout showing the location of machines, quality control, raw material storage, and the pathes the product will follow in arriving at the finished product storage area. This will give the student a good overview of the production system at a glance. (Appendix G, Page 12:7);
2. Students should be oriented to all the jobs involved in the production of the book holder. This means the teacher will

need to explain the jigs which have been prepared, and the operations which take place at each work station. The orientation might be accomplished as a plant tour. That is, the General Plant Manager leading a group of people through the factory explaining what happens to the book holder at various stages of production. Each work station might have a small sign giving the title of the job, the wage rate, and worker qualifications. In addition, each student could be provided with a procedure sheet to further his understanding of the production system. (Appendix I. Page 12:10).

3. Certain key personnel exist in a plant prior to the hiring of production workers. In order to recreate this situation the teacher shoudd(work with a few key students in advance. During the time the teacher is conducting the plant tour, a key student could serve as the Personnel Department. He would post the various job openings on the bulletin board and an envelope with the employment forms. (Appendix F. Page 12:5). Another key student could assist the Personnel Manager in the processing of these applications and selection of the production personnel. A third key student could serve in the capacity of foreman. As the people are employed, he would assist them in learning their job just as an actual foreman would.

SUMMARY

The transition from roleplaying to actual production can be a smooth one. The student can get a good understanding of the production system from the plant tour and information sheets. An approach of this nature does represent one way a manufacturer might open an all new assembly line. This approach utilizes peer leadership and begins to involve the more capable student in a situation he will find challenging and stimulating.

CONCLUDING STATEMENT

It is suggested that the teacher summarize the managed production system used to produce the book holder by involving the student in a discussion of the major concepts. This discussion should insure that all of the basic ideas of the managed production system fit in proper relationship for a clear student understanding of the manufacturing industry. An outline for such a discussion will assist to clarify the concept:

I. The purpose of management
    A. Planning
        1. Determination of the product
        2. Development of the design
        3. The relationship of the design to the product
        4. Product engineering
        5. Process engineering
            a. Jigs and fixtures
            b. Machines
            c. Tools
    B. Organizing
        1. Plant layout
        2. Personnel requirements
        3. Purchasing of materials

C. Controling

1. Personnel supervision

2. Operations (Material flow)

3. Inspection (Quality control)

II Production

A. Sequence of operations

B. Use of tools and machines

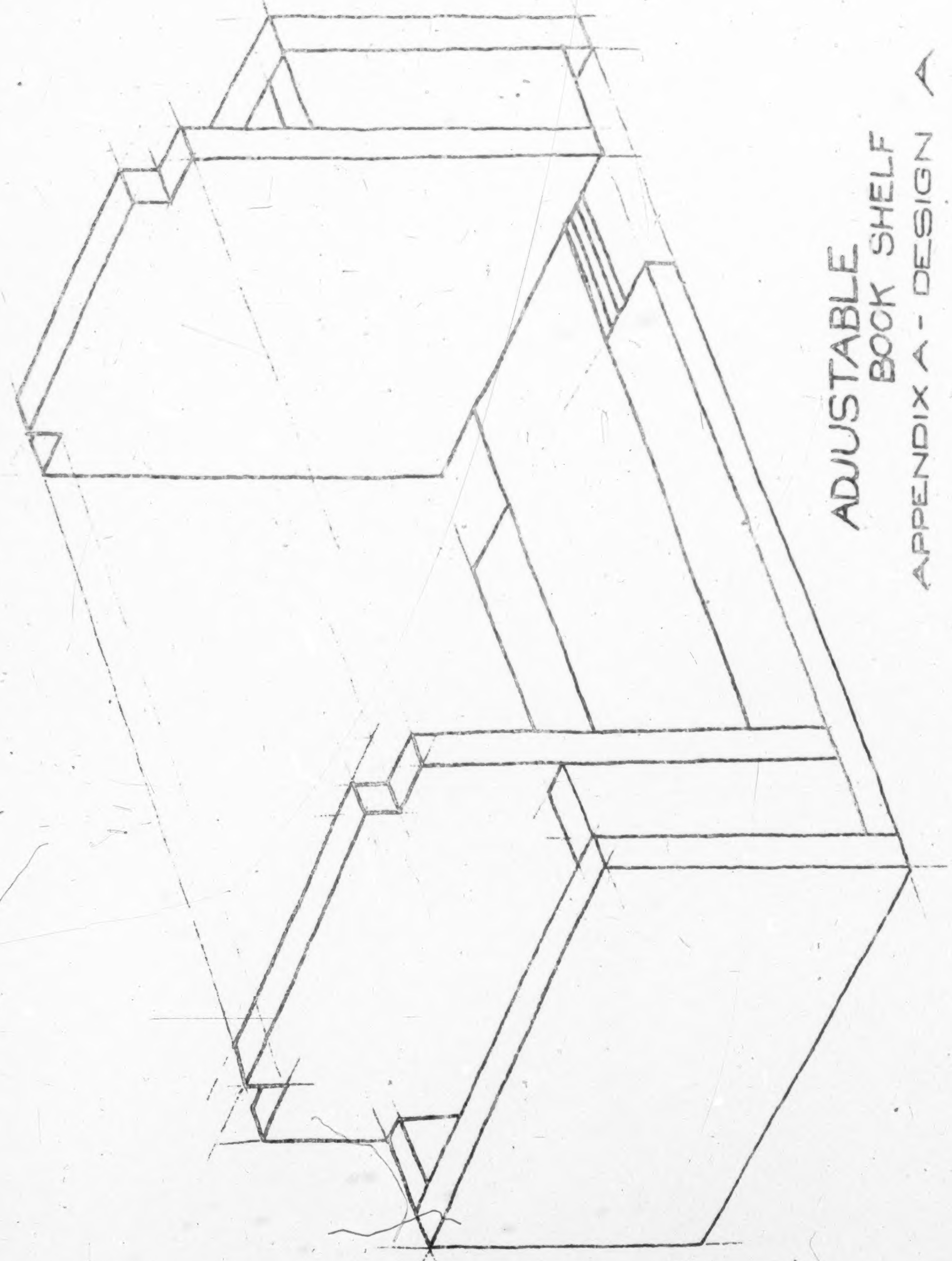
C. Production problems

III Distribution of the completed product

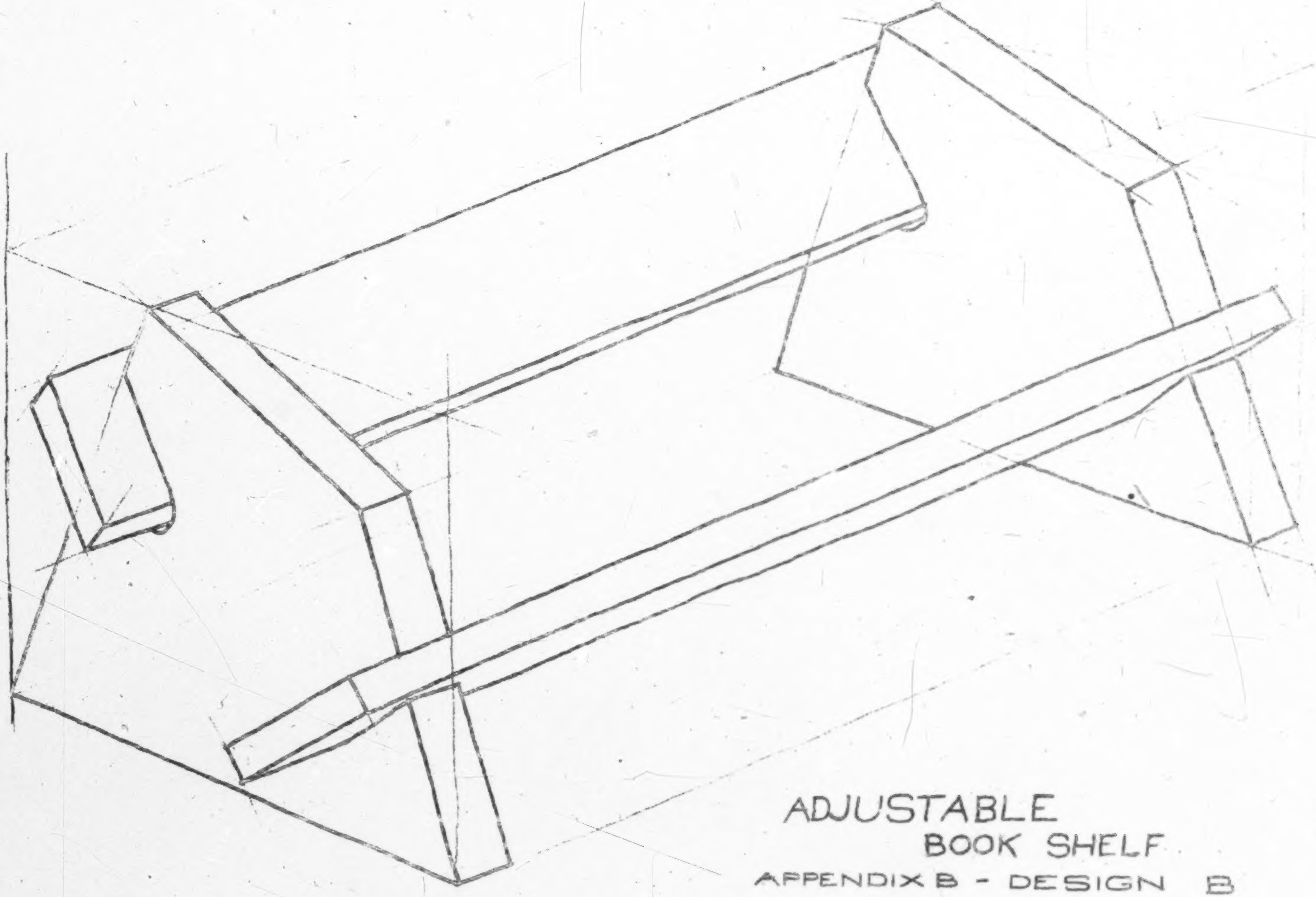
A. Methods of distribution

B. Costs

A test should be given, following this discussion, to evaluate the student's understanding of the managed production system. (Appendix R)

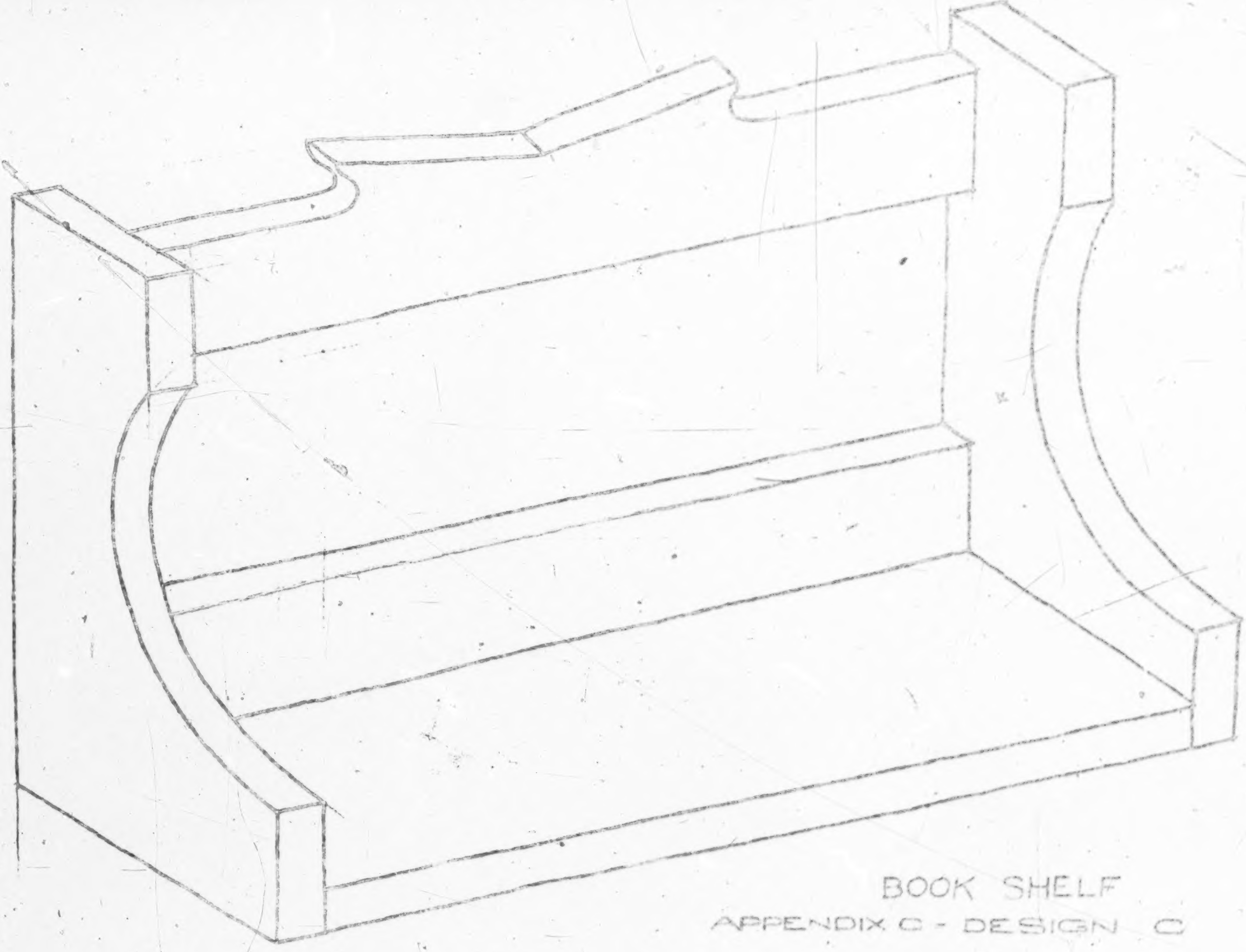


ADJUSTABLE
BOOK SHELF
APPENDIX A - DESIGN A



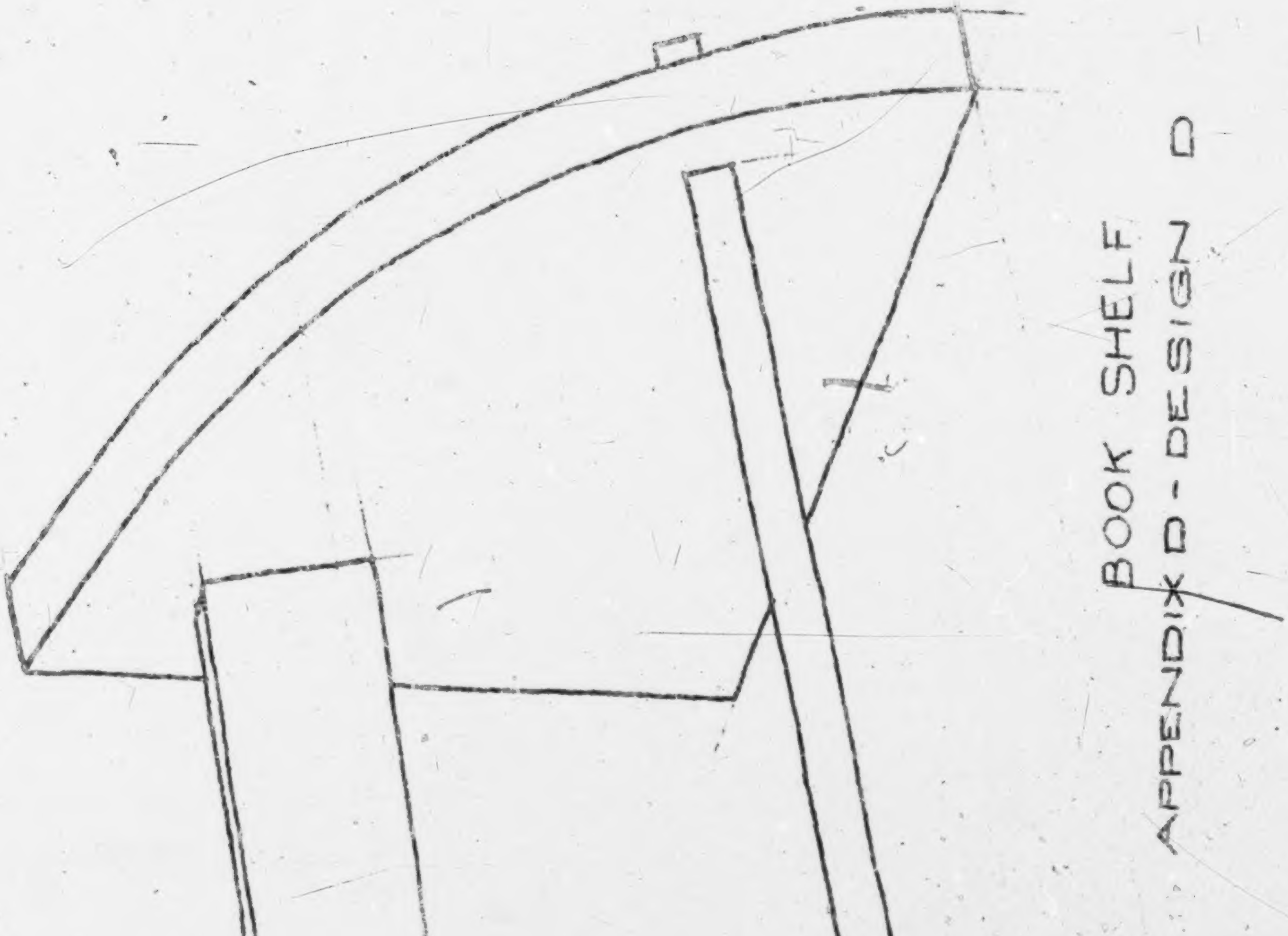
12:2

ADJUSTABLE
BOOK SHELF
APPENDIX B - DESIGN B



BOOK SHELF
APPENDIX C - DESIGN C

12:4



BOOK SHELF

APPENDIX D - DESIGN D

12:5

PERSONNEL DEPARTMENT

Job Specification

Title Drill Press Operator B

Department Production Salary $2.50/hour

Foreman or Supervisor J. Wilson Phone Ex. 542

Duties: Perform various operations on drill press.
Layout workpiece for drilling operations.
Set-up drill press for work piece.
Work with jig and fixtures, when applicable.

Hours 7:30 - 4:00 P.M. Shift 1 st

Vacation Two weeks, after one year of employment.

Promotion Drill Press Operator A, after one year.

Working Conditions Clean, well lighted and ventilated shop.

Minimum Qualifications:

Experience 1 year Education High School Age 21-40

Test Score Dext. B Intelligence C

Technical knowledge basic Technical Skills shown on test

References Check with previous employer and high school

Other Must be interested in remaining with company one year.

APPENDIX E. Job Specification Form

12:6

Please Print

PERSONNEL DEPARTMENT
EMPLOYMENT APPLICATION

Name______________________________________Date________
Last   First

Address__________________________________Phone________

Birth Date______________Age_____Grade_____H.R.________

Job Applied for:______________________________________

Tools actually used::_________________________________

____

Work experience:______________________________________

____

School activities:____________________________________

Outside activities:___________________________________

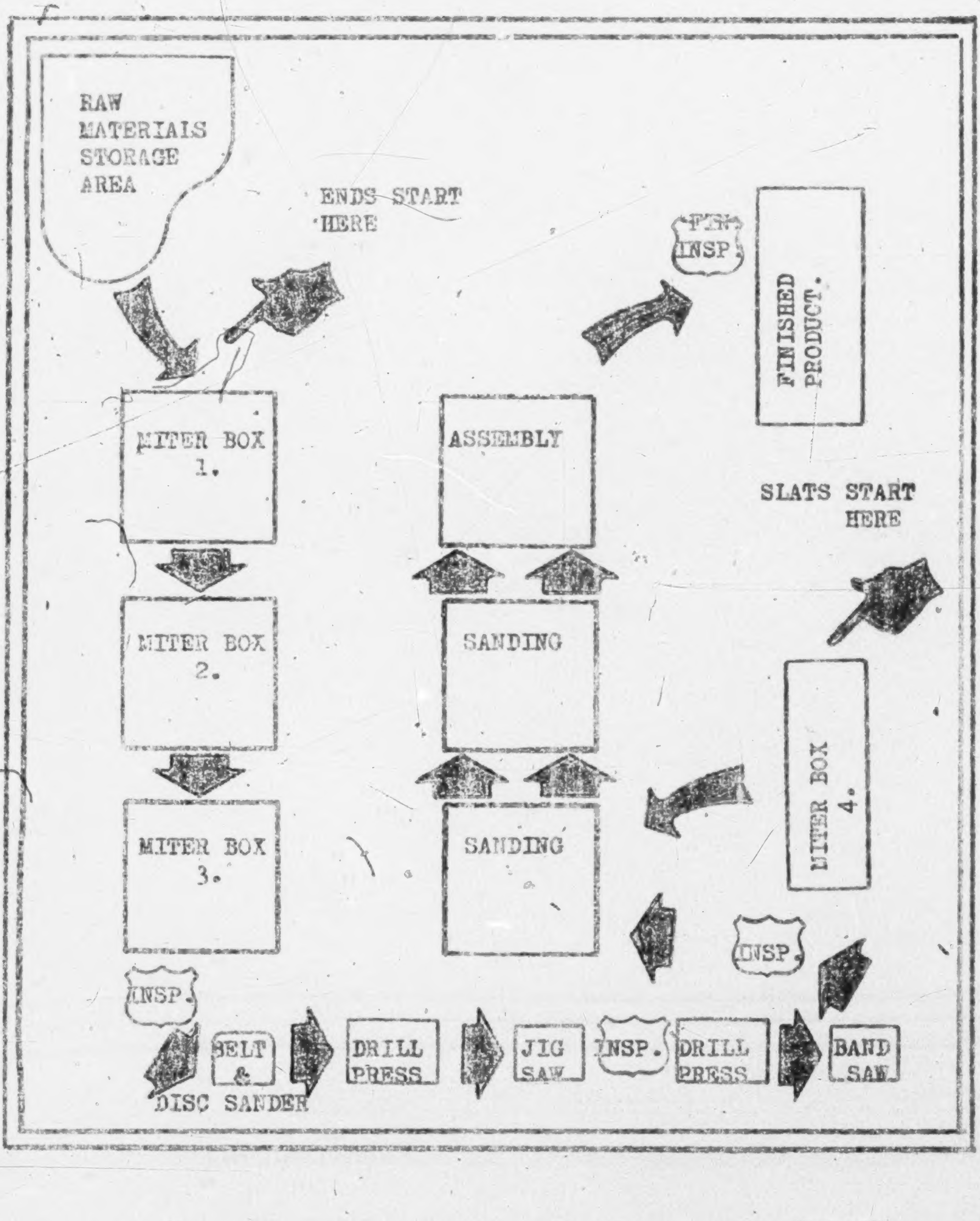
References:____

____

I certify that the above knowledge is true to the best of my knowledge.

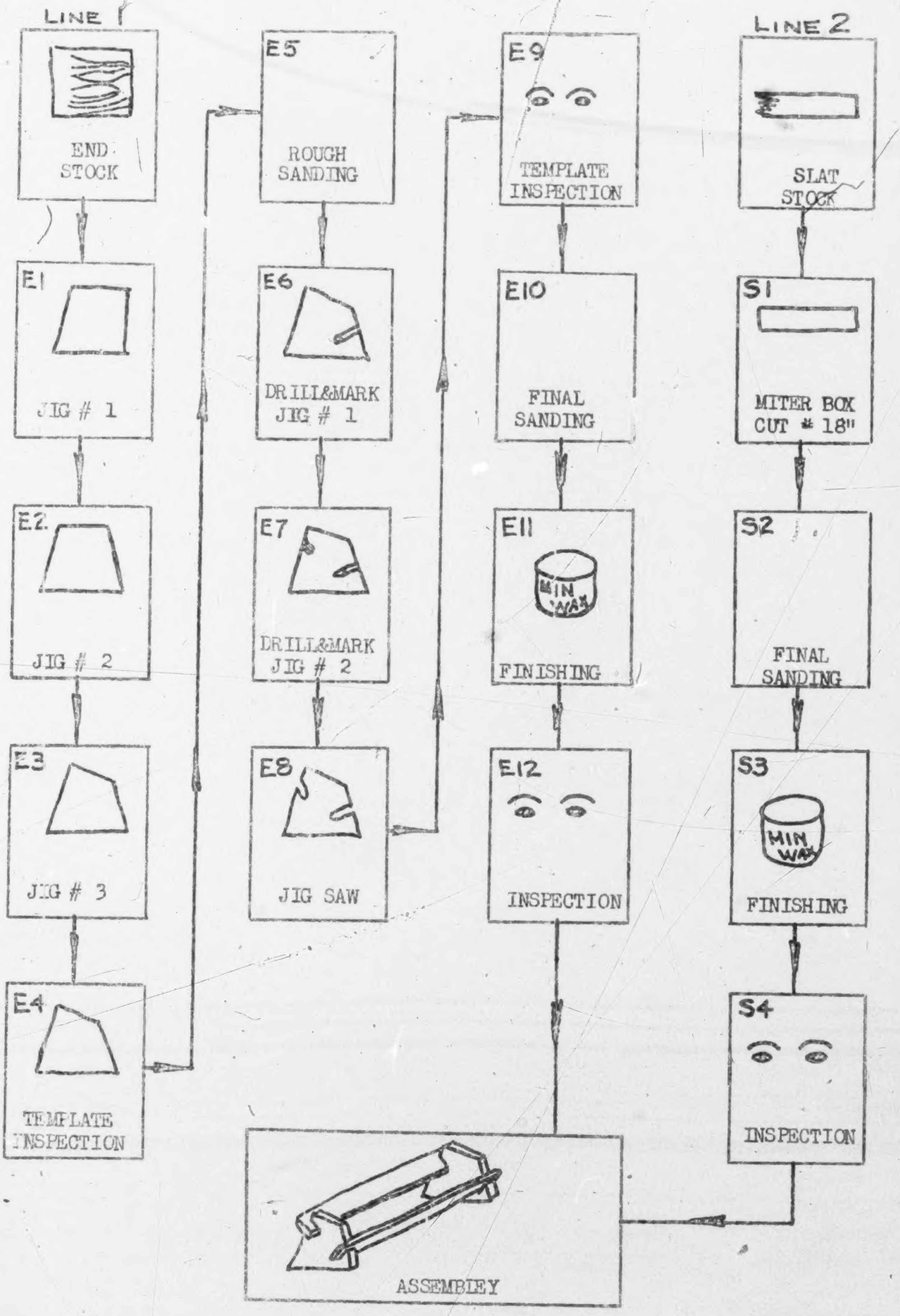
____
Applicant's Signature

APPENDIX F. Employment Application


RAW MATERIALS STORAGE AREA
ENDS START HERE
FIN. INSP.
FINISHED PRODUCT.
MITER BOX 1.
ASSEMBLY
SLATS START HERE
MITER BOX 2.
SANDING
MITER BOX 4.
MITER BOX 3.
SANDING
INSP.
INSP.
BELT & DISC SANDER
DRILL PRESS
JIG SAW
INSP.
DRILL PRESS
BAND SAW

APPENDIX G. A school shop organized as a plant would be for the production of the book holder.

12:8


LINE 1
END STOCK
E1
JIG # 1
E2
JIG # 2
E3
JIG # 3
E4
TEMPLATE INSPECTION
E5
ROUGH SANDING
E6
DRILL&MARK JIG # 1
E7
DRILL&MARK JIG # 2
E8
JIG SAW
E9
TEMPLATE INSPECTION
E10
FINAL SANDING
E11
MIN WAX
FINISHING
E12
INSPECTION
LINE 2
SLAT STOCK
S1
MITER BOX CUT # 18"
S2
FINAL SANDING
S3
MIN WAX
FINISHING
S4
INSPECTION
ASSEMBIEY

APPENDIX H: Flow Chart For Bookholder Production

APPENDIX I
PROCEDURE SHEET

Line one - Book holder ends

E1. 6½ x 8 piece of wood is taken from storage, placed in jig one and cut off with a back saw. The operator will then hand the stock to the operator of miter box jig no. 2.

E2. The piece of wood is next placed in jig 2 and another cut is preformed with a back saw. The operator hands the stock to the operator of jig. 3.

E3. The stock is now placed in jig. 3 and the final cut is made with a backsaw. The operator hands the stock to the inspector.

E4. The stock is inspected by laying a metal templet on top of the stock. The inspector transports the stock to the combination disc and belt sander.

E5. The stock is rough sanded using the disc for the four edges and the belt for the two sides. The person operating the belt sander transports the stock to the drill press operator.

E6. The stock is placed in the drilling and marking jig no. 1. A 9/16 hole is drilled and the operator marks the side of the slot. The operator hands the stock to the second drill press operator.

E7. The stock is now placed in drilling and marking jig no. 2. A second 9/16 hole is drilled and a second slot is marked. The operator transports the stock to the jig saw.

E8. The two slots are cut following the lines placed on the stock by the last operation. A sabor blade is used to get straight cuts. The jig saw operator hands the completed stock to the inspector.

E9. The stock is inspected by placing a metal templet on top and by sliding a piece of 1/2" slat stock into the slots. Corrections are made by the inspector with a wood rasp. The inspector takes the stock to the finish sanding area.

E10. Finish sanding is done by hand with 4-0 production paper. The stock is then passed on to the finishing area.

E11. Minwax finish is applied by hand, with rags and wiped dry. Several extra workers will be needed in this area. After the finish has been applied the parts go to final inspection.

E12. The object of the final inspection is to check the finish. If the finish is correct the parts go to the assembly area.

E13. If the book holders are going on display they should be assembled. If they are going into storage they should be left disassembled.

Line two - Slats

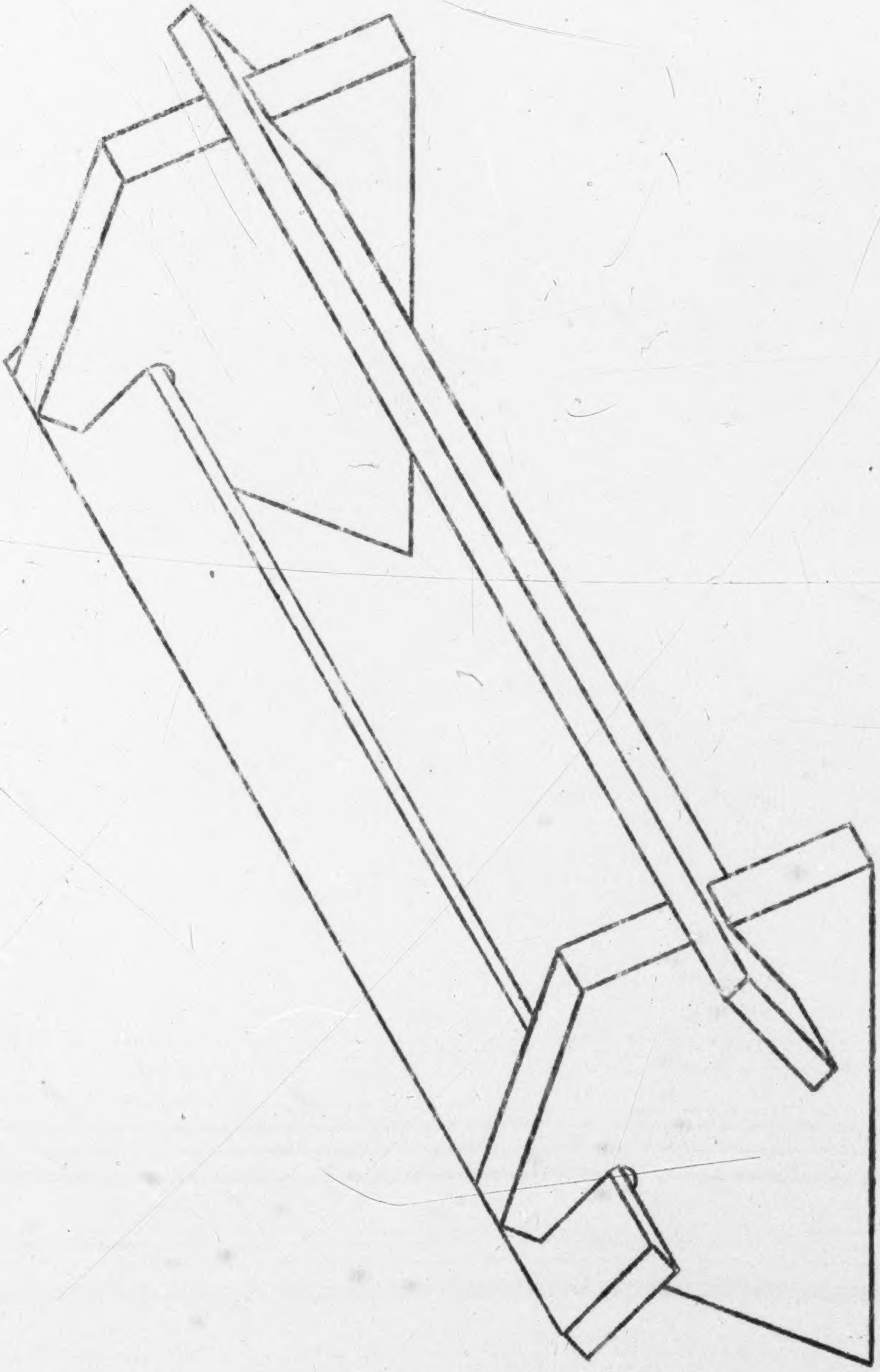
S1. ½" x 2" x 8' stock is taken from storage and cut into 18" lengths using a standard miter box. The operator hands the stock to the workman in the sanding area.

S2. The sanding is all done by hand with first 2-0 production paper and then by 4-0 production paper. The stock is then handed to the finishing area.

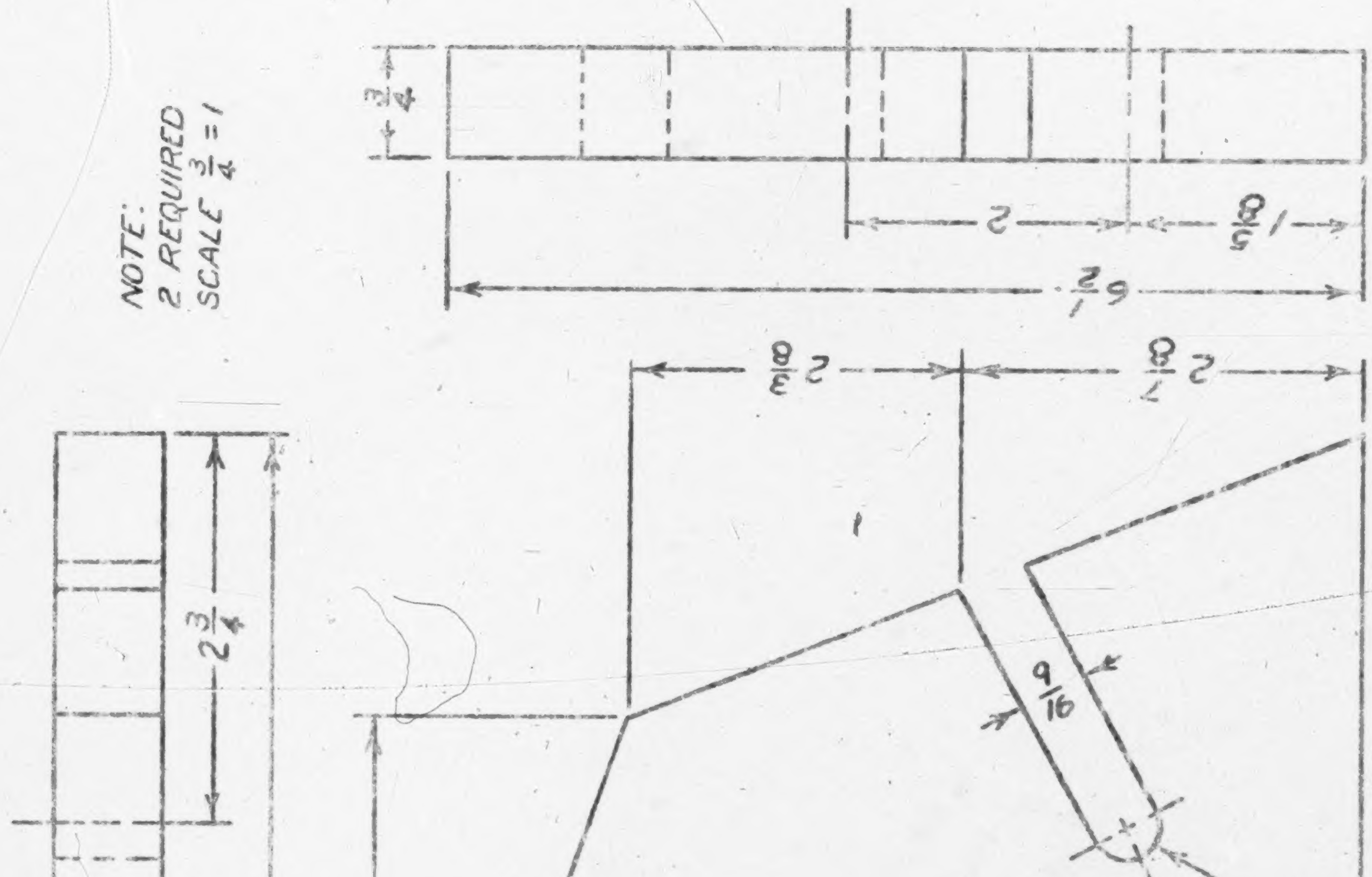
S3. Minwax finish is applied by hand, with rags, and wiped dry. Several extra workers will be needed in this area. After the finish has been applied the parts go to final inspection.

S4. The object of the final inspection is to check the finish. If the finish is correct, the parts go to the assembly area.

S5. If the book holders are going on display they should be assembled. If they are going into storage they should be left disassembled.

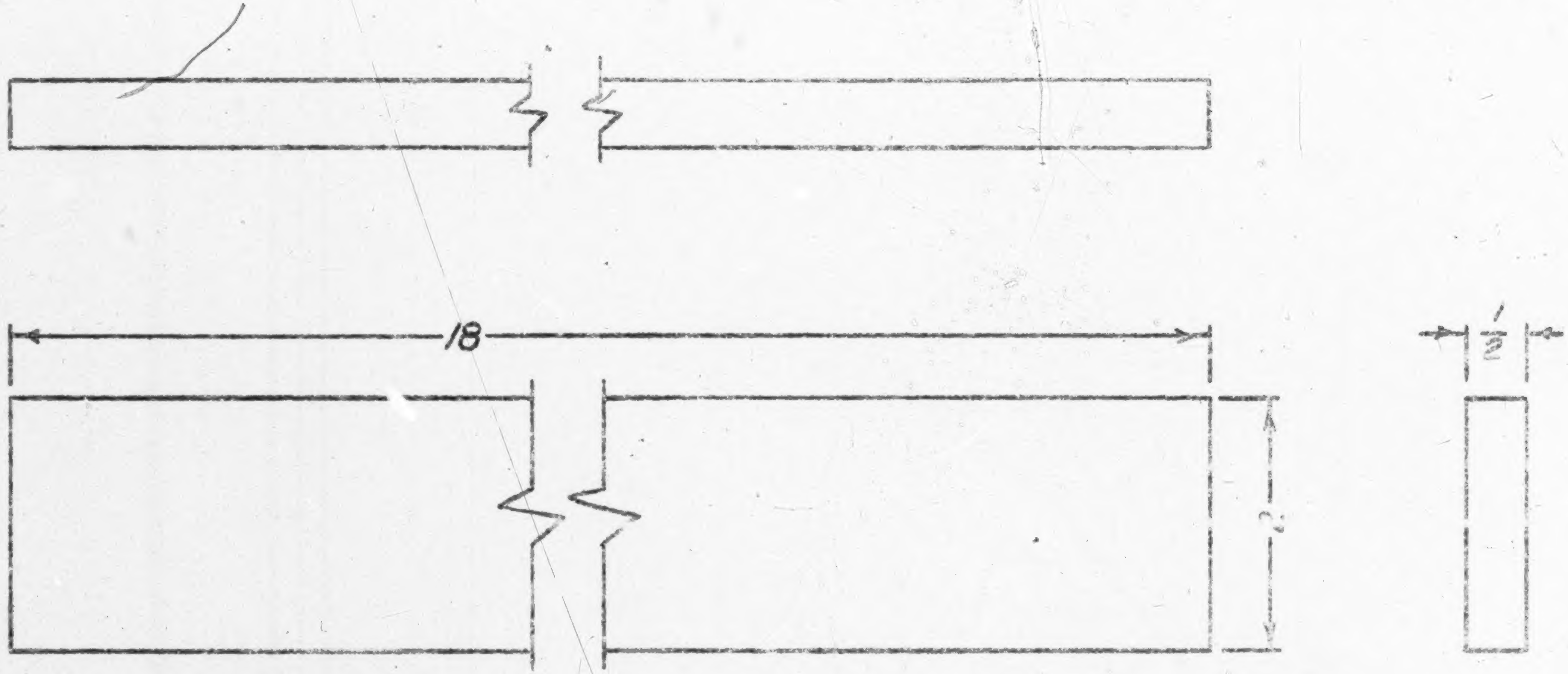


APPENDIX J. ADJUSTABLE BOOK HOLDER


3/4
2
1 5/8
6 1/2
2 3/8
2 7/8
1
9/16
3 5/8
2 3/8
1
9/16
2 3/4
8
2 3/4
9/16 DRILL
2 HOLES

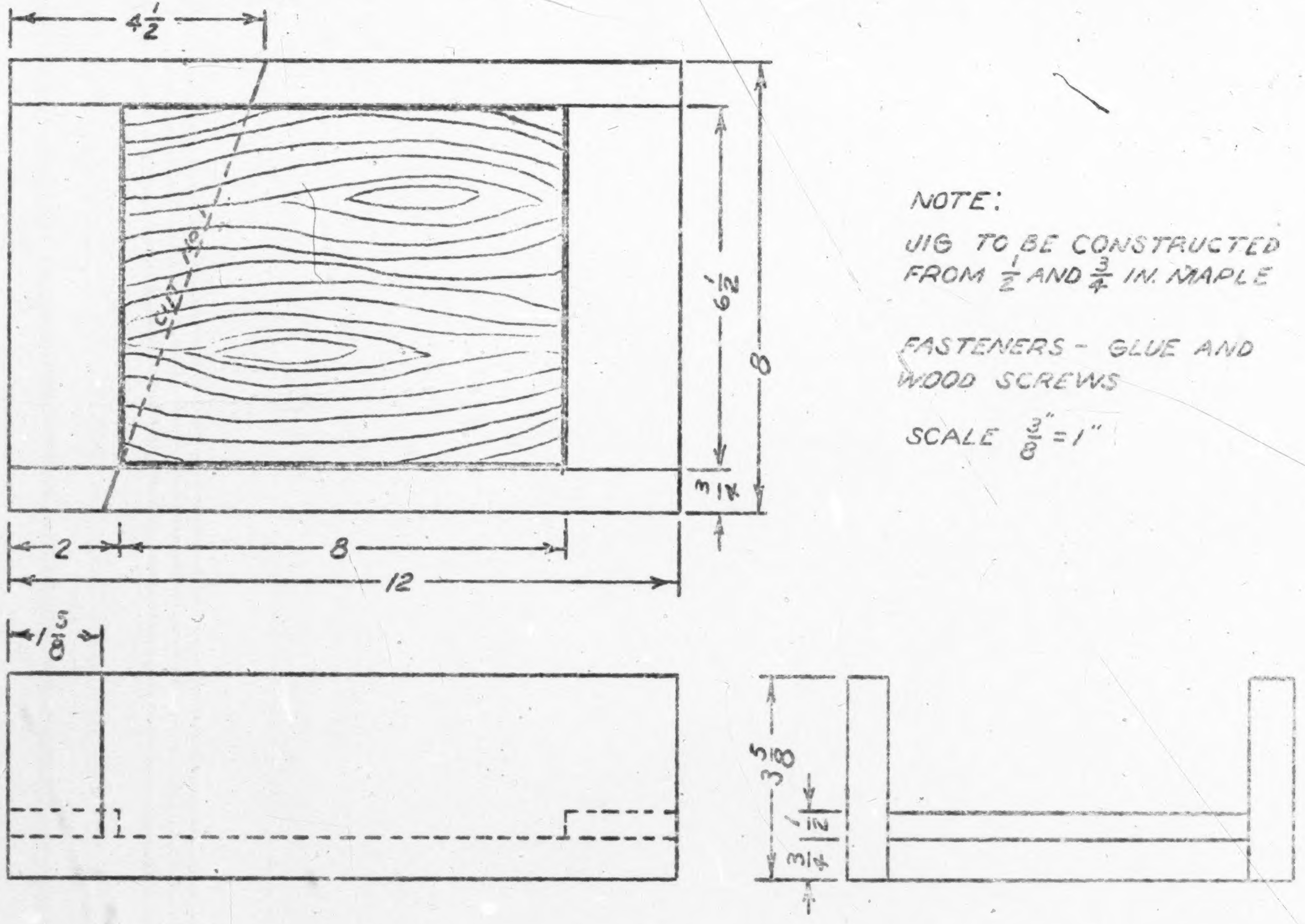
NOTE:
2 REQUIRED
SCALE 3/4 = 1

APPENDIX K. ADJUSTABLE BOOK HOLDER END



NOTE:
2 REQUIRED
SCALE $\frac{3}{4} = 1$

APPENDIX L. ADJUSTABLE BOOK HOLDER SLAT



$4\frac{1}{2}$
$6\frac{1}{2}$
8
$\frac{3}{4}$
2
8
12
$1\frac{5}{8}$
$3\frac{5}{8}$
$\frac{1}{2}$
$\frac{3}{4}$

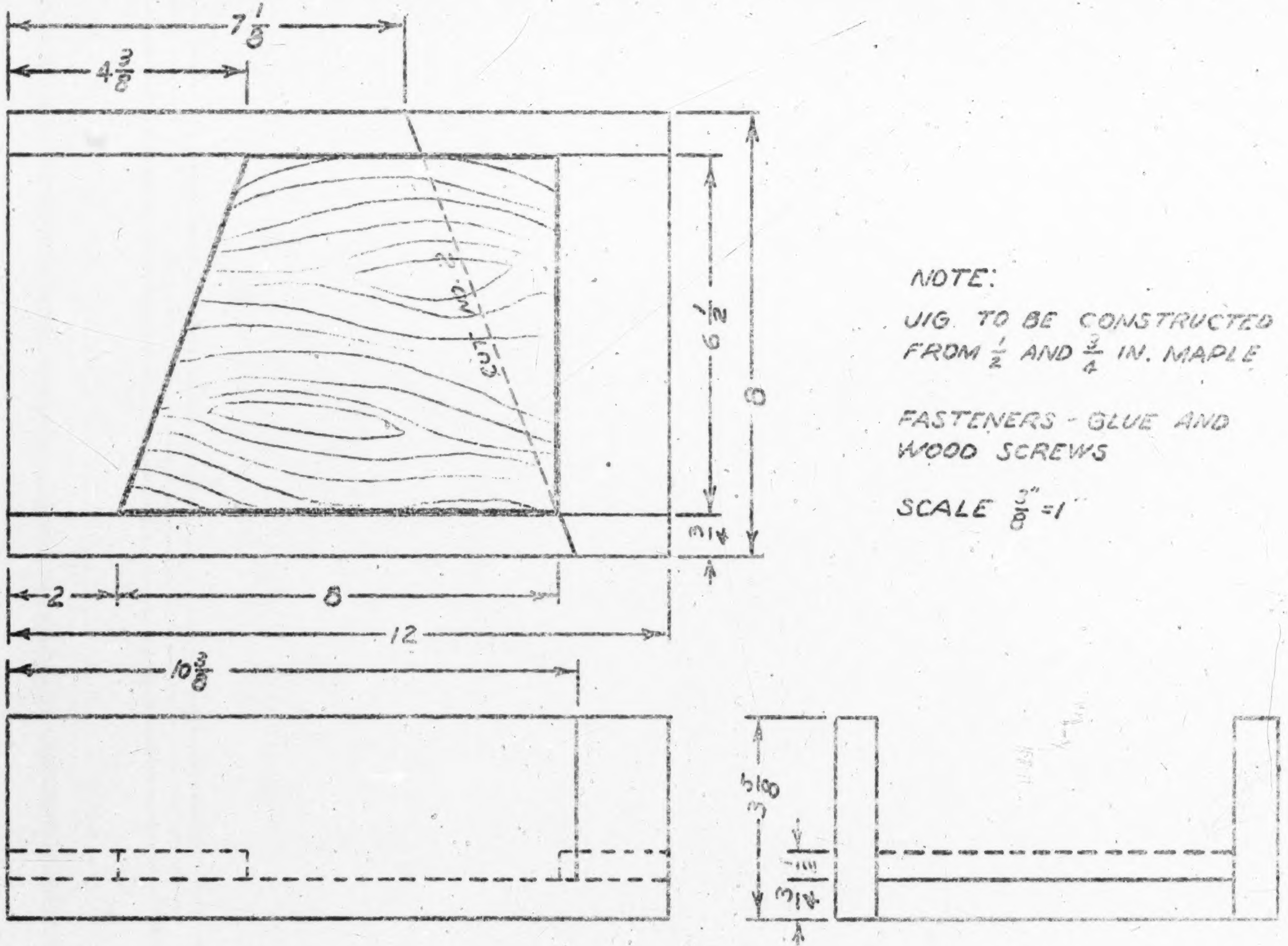
NOTE:

JIG TO BE CONSTRUCTED
FROM $\frac{1}{2}$ AND $\frac{3}{4}$ IN. MAPLE

FASTENERS - GLUE AND
WOOD SCREWS

SCALE $\frac{3}{8}'' = 1''$

APPENDIX M. MITER BOX JIG NO. 1


$7\frac{1}{8}$
$4\frac{3}{8}$
CUT NO. 2
$6\frac{1}{2}$
8
$\frac{3}{4}$
2
8
12
$10\frac{3}{8}$
$3\frac{5}{8}$
$\frac{3}{4}$

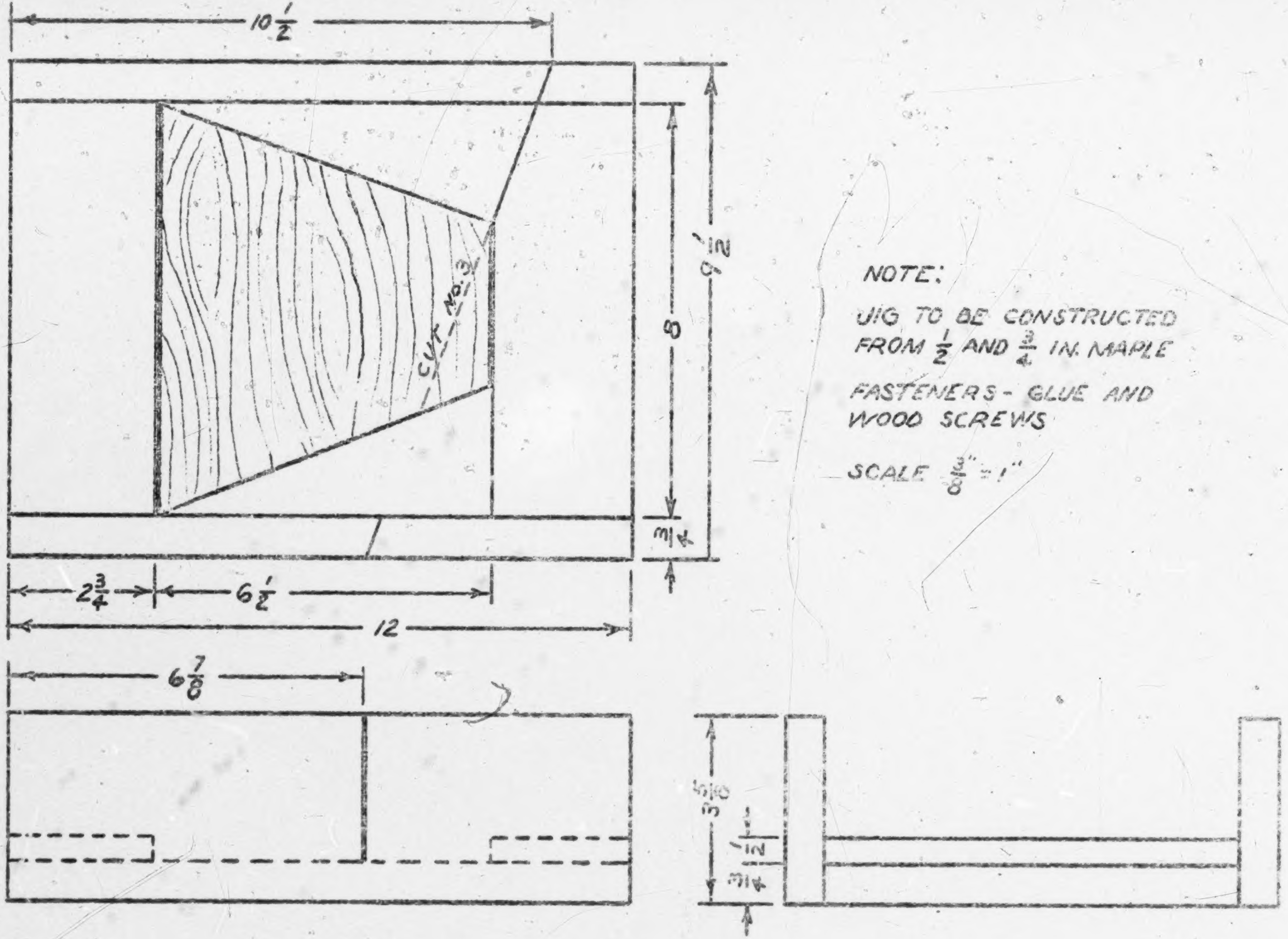
NOTE:

JIG TO BE CONSTRUCTED
FROM $\frac{1}{2}$ AND $\frac{3}{4}$ IN. MAPLE

FASTENERS - GLUE AND
WOOD SCREWS

SCALE $\frac{3}{8}$" =1"

APPENDIX N. MITER-BOX JIG NO. 2


10 1/2
9 1/2
8
3/4
CUT NO. 3
2 3/4
6 1/2
12
6 7/8
3 5/8
1/2
3/4

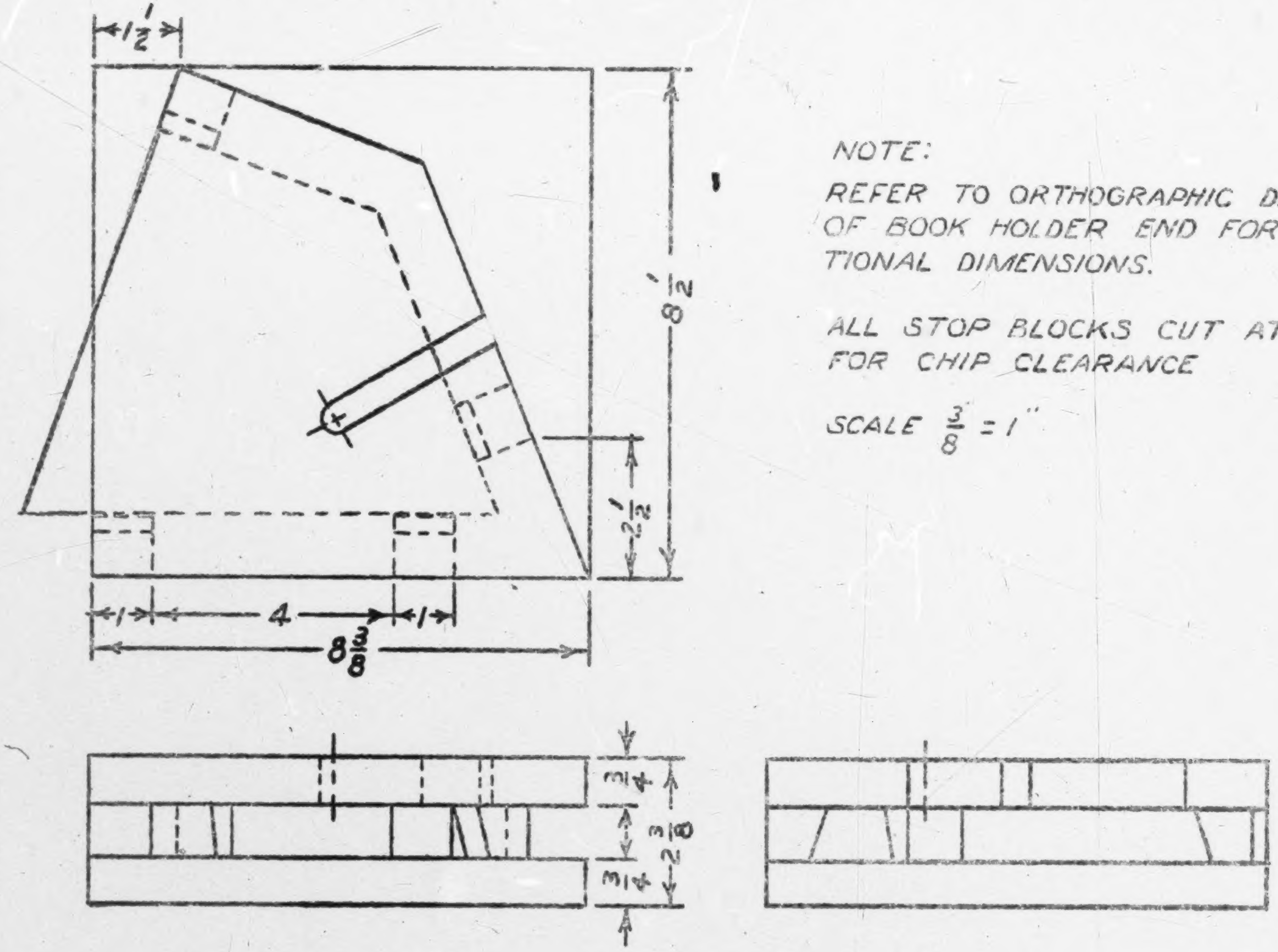
NOTE:

JIG TO BE CONSTRUCTED FROM $\frac{1}{2}$ AND $\frac{3}{4}$ IN. MAPLE

FASTENERS - GLUE AND WOOD SCREWS

SCALE $\frac{3}{8}$" = 1"

APPENDIX O MITER-BOX JIG NO. 3


$1\frac{1}{2}$
$8\frac{1}{2}$
$2\frac{1}{2}$
1
4
1
$8\frac{3}{8}$
$\frac{3}{4}$
$2\frac{3}{8}$
$\frac{3}{4}$

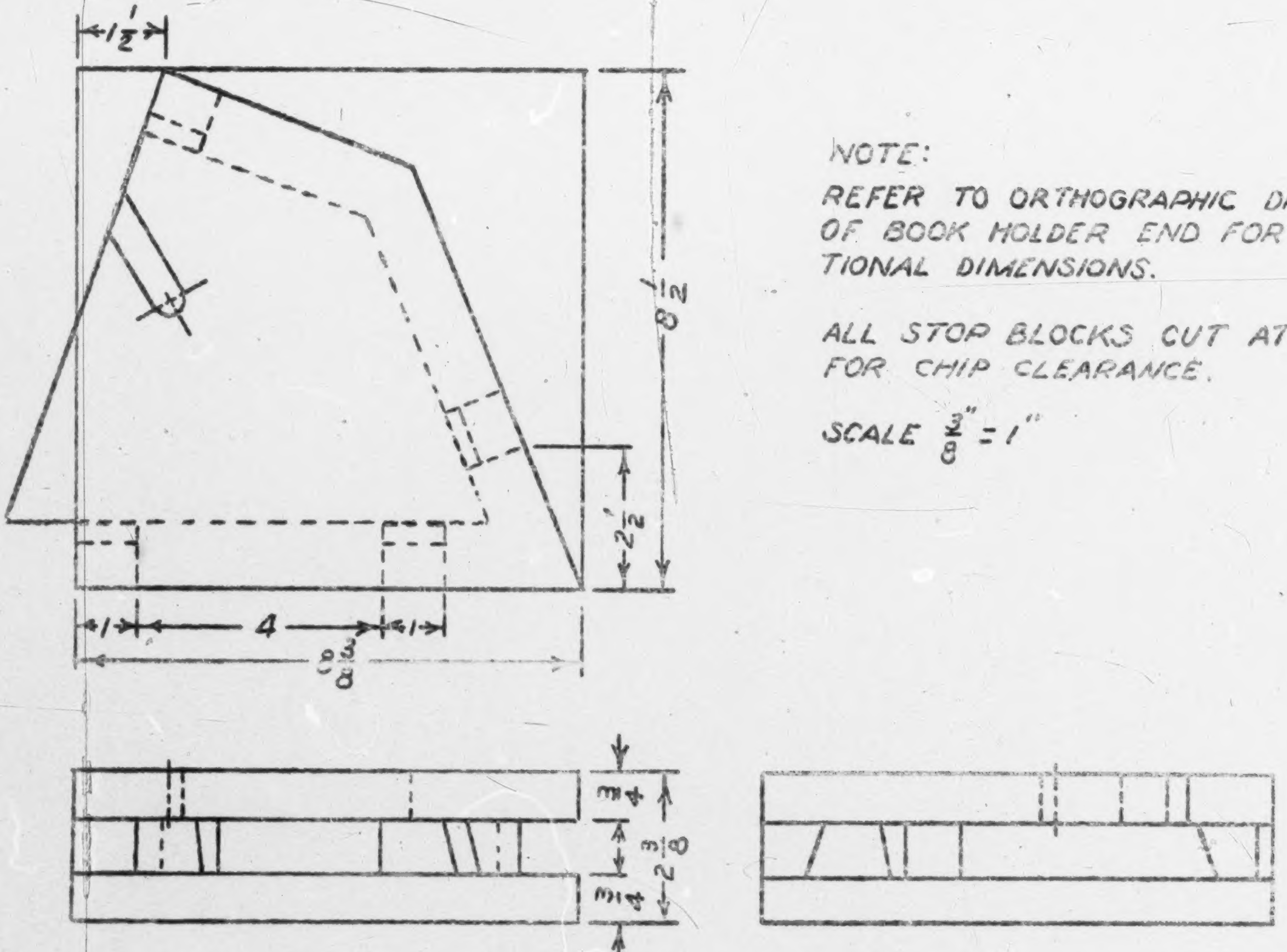
NOTE:

REFER TO ORTHOGRAPHIC DRAWING OF BOOK HOLDER END FOR ADDITIONAL DIMENSIONS.

ALL STOP BLOCKS CUT AT 15° FOR CHIP CLEARANCE

SCALE $\frac{3}{8} = 1''$

APPENDIX P DRILLING AND MARKING JIG NO. 1


1 1/2
8 1/2
2 1/2
1
4
1
8 3/8
3/4
2 3/8
3/4

NOTE:

REFER TO ORTHOGRAPHIC DRAWING OF BOOK HOLDER END FOR ADDITIONAL DIMENSIONS.

ALL STOP BLOCKS CUT AT 15° FOR CHIP CLEARANCE.

SCALE $\frac{3}{8}'' = 1''$

APPENDIX Q DRILLING AND MARKING JIG NO. 2

APPENDIX R - EXAMINATION

PART I - TRUE OR FALSE: Show your answer by circling the letter T or F next to each statement.

T F 1. The decision to manufacture a product is made by the product engineer.

T F 2. Product designers should be good artists.

T F 3. A wise factory owner will conduct a market analysis before deciding to manufacture a product.

T F 4. The designer makes the final decision as to which of his designs fulfills the requirements of the product.

T F 5. The product engineer determines the final sizes and materials to be used for manufacturing a product.

T F 6. Difficulty in getting materials sometimes determines which design will be used.

T F 7. If a factury does not have a machine needed to produce an attractive product, a second best design may have to be used.

T F 8. The designer's sketches serve the same purpose as the engineer's specification drawings.

T F 9. Jigs and fixtures can be bought in most lumber yards and hardware stores.

T F10. An inspection of the final product is usually all that is necessary in manufacturing.

PART II - MULTIPLE CHOICE: Circle the letter corresponding to the answer which most accurately completes the statement.

A B C D 1. The purchasing agent usually decides what material to order from: (A) The designer's sketches, (B) the process flow chart, (C) the product specifications, (D) the drawings of jigs and fixtures.

A B C D 2. If one of the local suppliers doesn't have one of the items needed to manufacture a product, the purchasing agent should: (A) check with the designer, (B) check with the engineer, (C) check with the market analyst, (D) decide for himself, before ordering a substitute item.

A B C D 3. The personnel manager's job involves: (A) workers, (B) tools, (C) machines, (D) material.

A B C D 4. The personnel manager knows what qualifications to look for when hiring workers by studying: (A) plant layout, (B) job specifications, (C) process flow chart, (D) engineering drawings.

A B C D 5. A hospitalization plan might be classified as a: (A) worker incentive, (B) job requirement, (C) operating expense, (D) fringe benefit.

A B C D 6. The production manager is concerned mostly with: (A) manufacturing the product, (B) designing the product, (C) building jigs and fixtures, (D) selling the product.

A B C D 7. Inspection is a function of: (A) manufacturing the product, (B) designing the product, (C) building jigs and fixtures, (D) selling the product.

A B C D 8. Assembly of parts is made easy because of (A) careful market analysis, (B) well designed tools, (C) interchangeability of parts, (D) skilled workers.

A B C D 9. The choice of finish for a product is determined by: (A) the company president, (B) the designer, (C) the product engineer, (D) the personnel manager.

A B C D 10. The method used to get the finished product into the hands of the consumer will affect (A) worker morale, (B) cost to the consumer, (C) future sales, (D) product design.

PART III - MATCHING: Place the letter A, B, or C next to each of the following items to show whether it is a function of Planning, Organizing, or Controlling.

_____ 1. Market analysis

_____ 2. Purchasing materials

_____ 3. Engineering

_____ 4. Determining needs for jigs and fixtures

_____ 5. Product design

_____ 6. Plant layout

_____ 7. Hiring workers

_____ 8. Process flow

_____ 9. Inspection of finished product

_____ 10. Supervision of production

(A) Planning

(B) Organinzing

(C) Controlling

KEY TO EXAMINATION

Part I True or False

1. F
2. T
3. T
4. F
5. T
6. T
7. T
8. F
9. F
10. F

Part II Multiple Choice

1. C
2. B
3. A
4. B
5. D
6. A
7. B
8. C
9. C
10. B

Part III Matching

1. A
2. B
3. A
4. A
5. A
6. A
7. B
8. A
9. C
10. C

ED 065731

industrial arts

ndea
institute
for
advanced
study

manufacturing

~~VT 015 771~~
VT 016 283

the ohio state university
1967

Instructional Materials

in

MANUFACTURING

for

Junior High School Industrial Arts

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION
THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL OFFICE OF EDUCATION POSITION OR POLICY.

Part III of IV

Product Synthesis B

Summer 1967

NDEA Institute for Advanced Study
in Industrial Arts
The Ohio State University
Columbus, Ohio
43210

Part III of IV

Product Synthesis B

Other Instructional Materials
In This Series

Generalized Manufacturing Technology
Regardless of Product Part I

Product Synthesis A Part II

Product Synthesis C Part IV

PREFACE

This synthesis unit in manufacturing was developed by eight participants of the 1967 Summer NDEA Institute for Advanced Study in Industrial Arts held at The Ohio State University. Two other product synthesis units similar to this one, together with the collection of units entitled "Generalized Manufacturing Technology Regardless of Product", complete the series of instructional materials developed during the eight week session.

Each group of eight men selected a product that could be manufactured in a junior high school industrial arts laboratory. They were encouraged to develop instructional materials that extend the structure of manufacturing technology as it had relevance for the product chosen. The materials have been written at approximately the 7th grade level of readability, and will be useful to teachers and pupils alike.

The general approach used by each group was common since the planned activities culminate in the operation of a managed production system in manufacturing. The means used in exemplifying this system, however, vary greatly. It is hoped that these units will spark the imagination of industrial arts teachers so that they will attempt new and better ways of interpreting the vasy system of manufacturing to junior high school pupils.

Arthur W. Earl, Professor
Instructional Materials
Development Workshop

INSTITUTE STAFF

Dr. Willis E. Ray, Professor of Education
The Ohio State University
Director of the Institute

Dr. Arthur W. Earl, Professor and Chairman
Department of Industrial Education and Technology
Montclair State College, Montclair, New Jersey
Instructional Materials Development

Dr. Donald R. Kibbey, Assistant Professor of
Industrial Engineering
The Ohio State University
Advanced Manufacturing Management, Personnel and
Production Technology

Dr. Donald G. Lux, Professor of Education
The Ohio State University
Advanced Industrial Arts Curriculum

Arthur J. Rosser, Doctoral student in
Industrial Arts
The Ohio State University
Administrative Assistant

John Butala, Jr., Doctoral student in
Industrial Arts
The Ohio State University
Instructional Assistant

Phillip A. Fazzini, Doctoral student in
Industrial Arts
The Ohio State University
Instructional Assistant

Miss Grace M. Twine--Secretary

CONTRIBUTORS

Product Synthesis B

Neil E. Ballard
Madison Junior High School
Abilene, Texas 79605

Delbert L. Ray
Gililland School
Tempe, Arizona 85281

James L. Cameron
Yorktown Junior High School
Columbus, Ohio 43227

Homer W. Settles
Bowling Green Junior High
Bowling Green, Ohio 43402

Robert W. Cutler
Irving Junior High School
Salt Lake City, Utah 84106

Clay F. Tanner
Dominion Junior High School
Columbus, Ohio 43224

Donald R. Darrow
Malcolm Price Laboratory School
University of Northern Iowa
Cedar Falls, Iowa 50613

William H. Wooden
Central Junior High School
La Porte, Indiana
46350

TABLE OF CONTENTS

Topic	Page
Introduction	1.1
Management Personnel	2.1
Product Design	3.1
Steel Processing	4.1
Product Planning	5.1
Finishing & Assembly	6.1
Production Personnel	7.1
Materials Handling	8.1

LIST OF APPENDICES

Appendix	
I	Stock Certificate & Cost Sheet
II	Assembly Drawing & Specifications
III	Working Drawing & Details
IV	Bill of Materials
V	Part A - Base
VI	Part B - Clamp
VII	Part C - Material Handling
VIII	Flow Chart
IX	Machines, Tools, & Equipment - Production
X	Special Equipment List
XI	Jigs & Fixtures Drawings
XII	Materials Handling Equipment
XIII	Templates
XIV	Purchase Order
XV	Application Form
XVI	Time Card

INTRODUCTION

OBJECTIVES

The student after studying this managed production system should be able to:

1. Give a brief review of industry, mass production, and management organization, and relate it to Manufacturing Incorporated's product, the note pad holder.

2. Relate the note pad holder, a mass production problem, to the managed production system of management, personnel, and production.

IMPORTANCE OF INDUSTRY

An alarm clock may have awakened you this morning. Many of you prepared for school using brushes, combs, and hair oil to groom your hair. You sat down to breakfast prepared on a gas or electric stove. You may have had toast from an automatic toaster. Some of you may have written a note, on a note pad holder, so that you would be sure to remember some important weekend activity. You were reminded of the time either by a clock or maybe a radio. Many of you rode to school in autos or on a bus. All of these things you have used, plus many others not mentioned here, are products of industry. Industry is the organized efforts of many workers, combined into a managed production system, to produce the things we want and need.

Industry takes the raw material and transforms (changes) it into the things that people want. There are several main steps involved in this process. First, there must be raw materials available. Second, there must be people to do the work. Third, there must be money to finance the operation. All of these things when brought together in a managed production system, forms the company that makes the product. Then after the goods are produced, they are sold for a profit.

MASS PRODUCTION

Most of the products and goods we use or come in contact with each day have been mass produced. Mass production means the producing or making of things in large quantities or numbers. Almost everything made in our country today is mass produced. Becauso of mass production Mom is able to get repair parts for her washing machine. Also, Dad can get exact replacement parts for the family auto in case of breakdown. Mass production methods will be used to produce a note pad holder in this class.

Mass production has led to specialization of labor. The parts and work are moved on an assembly line to the worker. Each worker then becomes skilled in a single operation. An assembly line will be set up in class to produce the note pad holder. Through the efficient use of labor, tools, and machines, industry is able to produce large quantities of finished goods. These goods can be produced at less cost than by hand methods.

ORGANIZATION

All of the functions or operations of an industry are a direct responsibility of management. The need for good managers (people who run the business) has increased with the complex industries of today. Industries, whether small or large, must produce goods that will sell or they will go out of business. A business must show a profit to succeed. Therefore, wise decisions based on the objectives of the company must be made.

The good use of material, tools, machines, and labor must be planned carefully through the entire process of production. Those in charge must decide what is to be made and how it is to be done. Materials must be available when and where it is needed. The work must be planned step by step from the beginning to the finished product.

Many people are involved in management. Management includes men like the president, vice-presidents, foremen, and supervisors. Each plays an important part in the production process. You will be able to see how this process works as you participate in the activities of a typical industrial company. This will be done by mass producing a note pad holder.

THE PRODUCT

Manufacturing Incorporated is a small company engaged in the production of household gadgets. Through their market research it has been determined that there is a need for a new product. This product is a note pad holder. Design and production planning people are to study the new product. They are to see if the note pad holder can be worked into a production line. Personnel people have also been alerted to hire more workers.

SUMMARY

The goods and materials we use each day are products of industry. Almost all of these products have been mass produced. Industry needs good managers and workers.

The next few days are to be spent in working as industry does. You will do some organizing and planning. After this has been done you will mass produce the note pad holder. The note pad holders are to be given to the class members. The students will then evaluate the experience through a group discussion.

LABORATORY ACTIVITY

Objective. The student, after participating in the laboratory activity, will be able to:

1. Understand the meaning of industry and mass production.

Activity. Film on industry

The Rogue

MANAGEMENT PERSONNEL

OBJECTIVES

The student should understand:

1. The responsibilities of management personnel by organizing the corporation that will manufacture the note pad holder.

2. The sale of stocks, through the financing of the corporation.

3. The various costs involved in the manufacture of the note pad holder.

4. The principles of marketing, through the note pad holder sales.

INTRODUCTION

The type of enterprise that will manufacture the note pad holder will be a corporation. It will be called Manufacturing, Inc.. A corporation is a group of people who can act as a single person, in legal matters. It can be fined, sued or dissolved, but it cannot be put in prison. It will be organized into a line and staff type of organization. A line organization is like in the military---one man is directly in charge of another. A staff organization is where individuals are equal in authority to other staff members. Manufacturing, Inc., is organized by using a combination of these organizations. It will consist of stockholders, a Board of Directors, and the President of the company. There will be a department for Finance Engineering, Personnel, Production and Marketing. There will also be a Vice-President in charge of each one of these departments. Other personnel will be grouped within these departments. (Fig. A.)

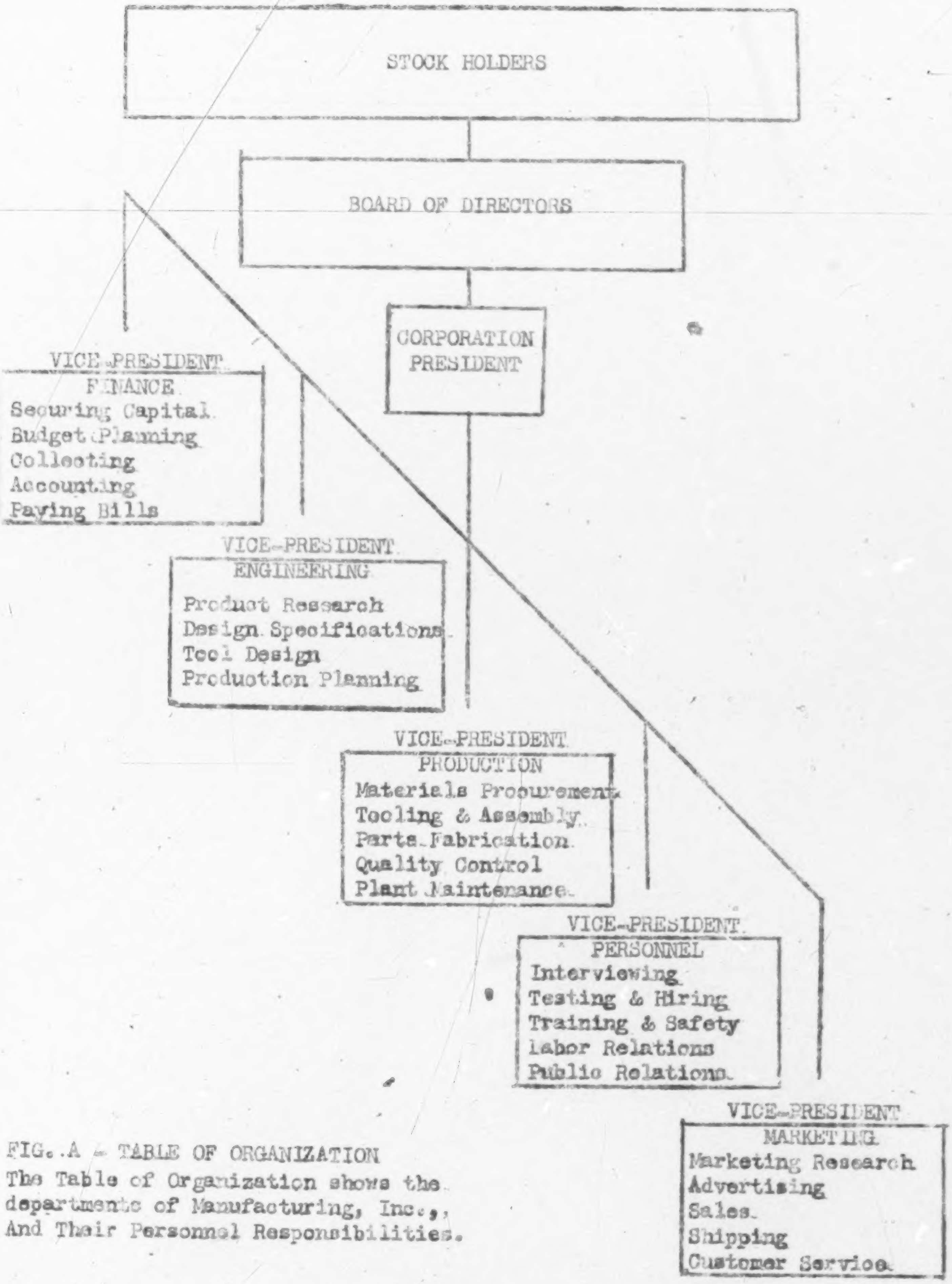

STOCK HOLDERS
BOARD OF DIRECTORS
CORPORATION PRESIDENT
VICE-PRESIDENT FINANCE
Securing Capital
Budget Planning
Collecting
Accounting
Paying Bills
VICE-PRESIDENT ENGINEERING
Product Research
Design Specifications
Tool Design
Production Planning
VICE-PRESIDENT PRODUCTION
Materials Procurement
Tooling & Assembly
Parts Fabrication
Quality Control
Plant Maintenance
VICE-PRESIDENT PERSONNEL
Interviewing
Testing & Hiring
Training & Safety
Labor Relations
Public Relations
VICE-PRESIDENT MARKETING
Marketing Research
Advertising
Sales
Shipping
Customer Service

FIG. A - TABLE OF ORGANIZATION
The Table of Organization shows the departments of Manufacturing, Inc., And Their Personnel Responsibilities.

ORGANIZATION OF MANUFACTURING, INC.

Stockholders are the actual owners of the corporation. These are people who have bought shares in the corporation. A Certificate of Stock is evidence of a stockholders share. The stockholders elect the Board of Directors for the corporation.

Board of Directors of Manufacturing, Inc., are the top management of the corporation. These are eight people elected by the stockholders. The teacher will act as the Chairman of the Board. The Board will establish the basic policies of the corporation. They will also select the President of the corporation, and approve his recommendations for Vice-Presidents.

President of the corporation is the chief executive of the organization. He has the responsibility for general management. He must also understand the general functions of the various departments. These functions will be listed and defined under each department.

Vice-President - Finance Department. This person will be concerned with the money to operate the corporation. The size of his department will be the number necessary to assist him in the sale of stocks and keeping the corporation budget. An example of a stock certificate and a simple bookkeeping form are included in the appendix. Those in this department will establish the price of the note pad holder by determining the following items:

1. Cost of raw materials
2. Direct costs (Labor)
3. Indirect costs (Overhead) 50% of raw material
4. Total cost
5. Profit (20% of total cost)
6. Manufacturer's price (Total cost and profit)

Stock Certificates will be sold at the price determined by the Board of Directors. A certificate of stock denotes partial ownership of a corporation. These certificates will be redeemed at *par value* plus any dividend they have earned at the time the corporation will be dissolved. Par value is the original cost of the stock. These stocks are transferable.

Vice-President - Engineering. He will be responsible for the design and specifications of the note pad holder. The size of his department will be determined by the amount of development and redesign necessary for the product. He and his department should always seek better ways to manufacture the product.

Vice-President - Production. He will consult with the Engineer as to materials, tools, and machines necessary to manufacture the note pad holder. He will be responsible for seeing that the product will be made, finished, and assembled according to specifications. Shop maintenance will also be his responsibility. The size of his department will be determined by the number of production workers needed.

Vice-President - Personnel. He will work with all the Vice-Presidents to determine the personnel needed to man their departments. His department should have enough people to help him interview, train and retrain people for different jobs. He should understand the different qualifications for each job and promote the good characteristics that each worker should have.

Vice-President - Marketing. His responsibility is to advertise and sell the product. His department will recommend the number of note pad holders to be manufactured and sold. This record, along with the money from sales, will be turned over to the Finance Department. The size of his department will be determined by the method selected to market the product.

The following marketing methods can be considered:

1. Direct sales -- The salesmen work for the manufacturing company and sell directly to the consumer.

2. Selling to Stores - The salesmen sell to retail stores who resell the product.

3. Selling on Consignment - The salesman doesn't work for the corporation, but pays for the items he can sell and returns the rest.

4. Display Room Sales - An attractive display room must be obtained and maintained with someone responsible for the resulting sales.

Any of these methods or a combination of methods could be used to sell the note pad holder.

SUMMARY

Manufacturing will be the type of organization that will manufacture the note pad holder. The stockholders are the actual owners of the corporation. They elect a Board of Directors, who select the President of the corporation. The President is the chief executive with five (5) Vice-Presidents assisting him. Each Vice-President will be in charge of a separate department. These departments are: Finance, Engineering, Production, Personnel and Marketing. Other personnel will be grouped according to the need in these departments.

PRODUCT DESIGN

OBJECTIVES

The student, after study of this material, will be able to:

1. Understand the steps in designing the note pad holder.
2. Realize that product design is a series of compromises.
3. Analyze the material and functional requirements of the note pad holder.

INTRODUCTION

The class has agreed to manufacture note pad holders. It was further decided to design and manufacture the holder as industry would produce them. This will allow us to understand more about industry.

Manufacturing companies are in business, as you are, to make and sell products. Their products are made with the hope of making profits. Their profits are largely dependent upon the design of their products. If their products are well designed, they are likely to sell in large numbers. If not, the manufacturing company is likely to go out of business.

The design phase in production is a very important task. Much thought should be given to product design. In this unit, you will see how the designer might design a note pad holder for production. You will see how it is a step-by-step process. The design steps are (1) Analyzing the Product, (2) Collecting Design Solutions, (3) Testing and Experimenting with Solutions, (4) Selecting the Final Design Solution, (5) Building the Prototype, and (6) Drawings and Specifications.

ANALYZING THE PRODUCT

To analyze is to study something. The designer must first analyze his problems before he starts the design of the holder. These problems may be studied by thinking about the functional and material requirements of a note pad holder.

Functional requirements. Several major functional requirements for a note pad holder are suggested below. The note pad holder should:

1. Hold a 1/2"x4"x5" or smaller pad tightly.
2. Allow for the pad to be simply and easily changed.
3. Be good looking.
4. Not scratch the desk top.
5. Have storage space for one pencil without breaking the point.
6. Have a sturdy flat writing surface.
7. Be heavy enough to prevent skidding while writing.

Material requirements. Several major material requirements for a note pad holder are suggested below. The note pad holder should:

1. Use materials wisely.
2. Be made of sheet metal stiff enough to support writing.
3. Be made of sheet metal that can be easily drilled, cut and bent.
4. Be made of a metal that will allow paint to stick.
5. Be made in the industrial arts laboratory with available tools and machines.

You can see that there are many things to think about in product design. We have already answered many detailed questions about the note pad holder. These details are the product specifications. They are necessary to guide the designer in developing his ideas. As his ideas develop he works out the details of the specifications.

COLLECTING DESIGN SOLUTIONS

At this point, the designer would sketch several holders using the basic specifications to guide him. The more ideas the designer has, the better. When he has several ideas down on paper, he can choose his best idea for production. (Fig. A)

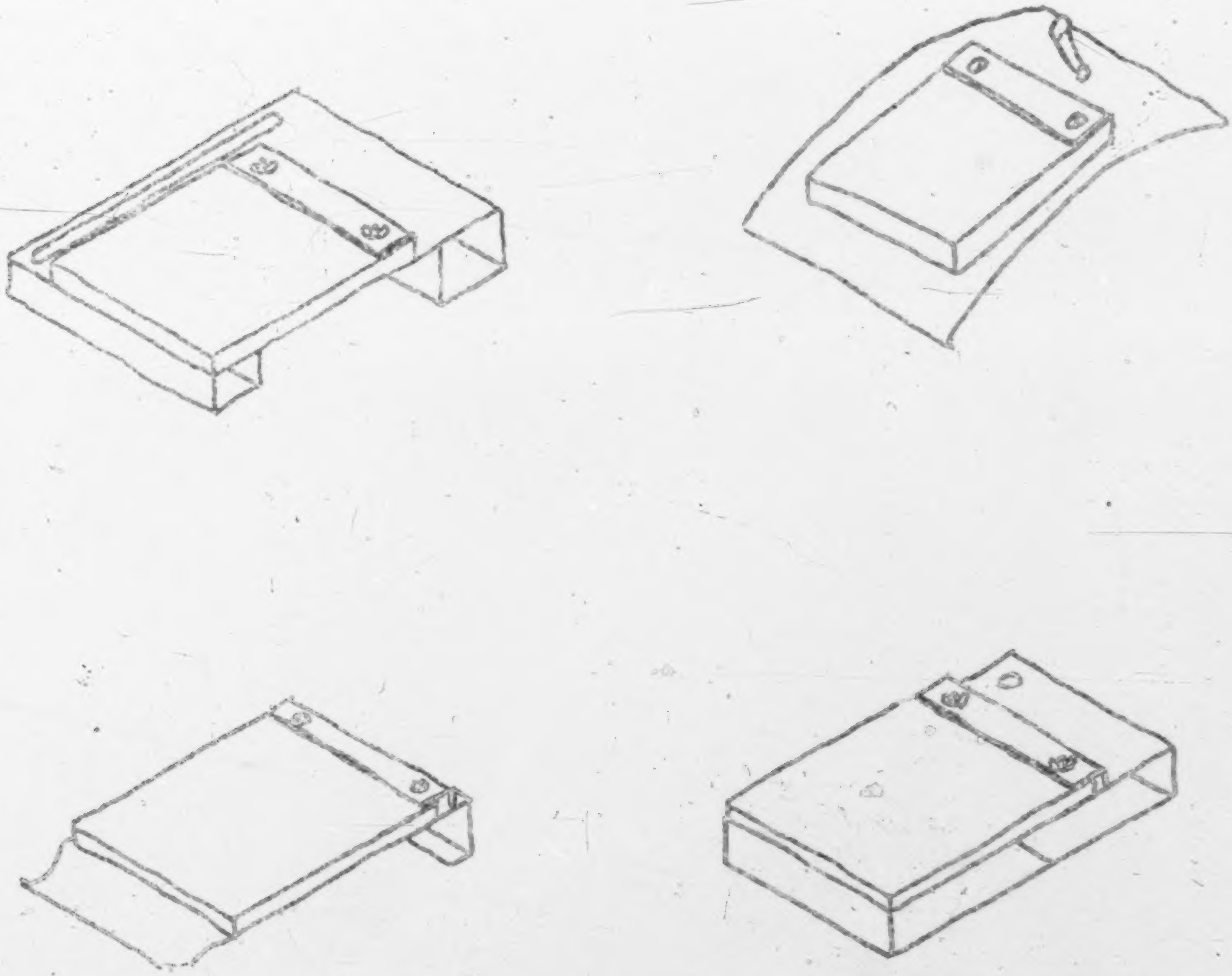


FIG. A. NOTE PAD HOLDER DESIGNS: The designer sketches many ideas before selecting the final design.

These design ideas are not all the same. Some ideas are better than others. Each design has its own advantages and disadvantages.

TESTING AND EXPERIMENTING WITH SOLUTIONS

The designer must, in some way, choose his best design. He analyzes the advantages and disadvantages of each of his ideas. He finally decides by testing and experimenting with his four design ideas.

The designer must organize his thinking so he can do testing and experimenting. One way to do this would be to study the functional and material requirements.

Functional requirements may be divided into three groups for study. They are: (1) Support for the pad, (2) Pencil storage, and (3) Pad clamp.

1. Support for the pad is the main function of the holder. The pad size is 1/2"x4"x5". The designer tries to decide which of the four shapes best serves the basic function. Let us study each of the four shapes. (Figs. B,C,D,E).

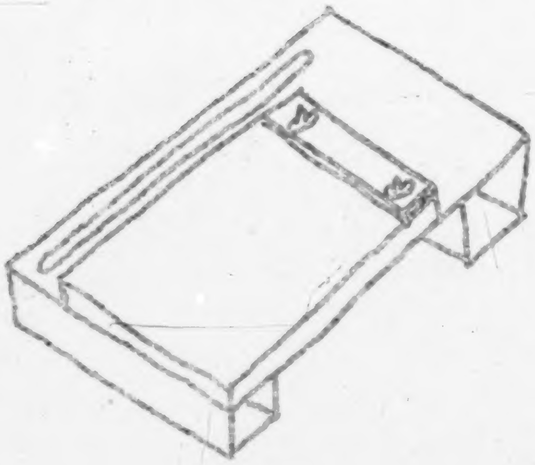


FIG. B

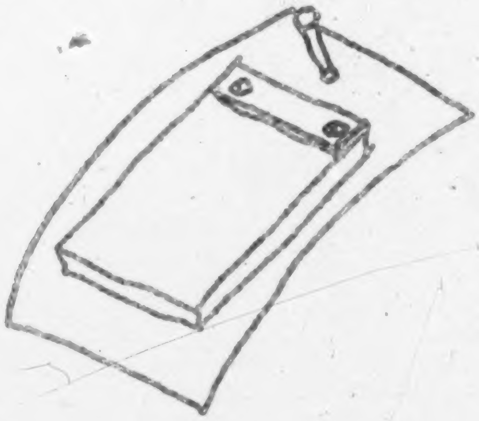


FIG. C

FIG. B. ADVANTAGES

1. Strong, flat writing surface
2. Does not scratch desk top

FIG. C. ADVANTAGES

1. Good looking shape
2. Simple construction

FIG. B. DISADVANTAGES

1. Waste of materials
2. Poor looking shape

FIG. C. DISADVANTAGES

1. No flat writing surface
2. Scratches desk top

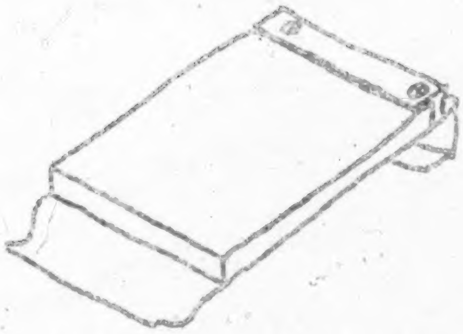


FIG. D

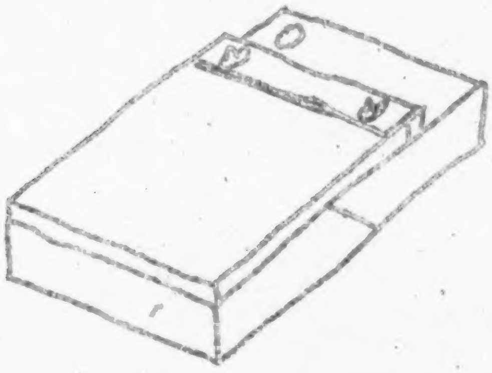


FIG. E

FIG. D. ADVANTAGES

1. Strong flat writing surface
2. Does not scratch desk top
3. Good looking shape
4. Good use of materials

FIG. D. DISADVANTAGES

1. Difficult construction.

FIG. E. ADVANTAGES

1. Strong flat writing surface
2. Simple construction

FIG. E. DISADVANTAGES

1. Poor looking shape
2. Waste of materials
3. No slope to writing surface

2. Pencil storage is another function of the holder. The holder should store one pencil without breaking the point. Let us study each of the four pencil functions. (Fig. F, G, H, I).

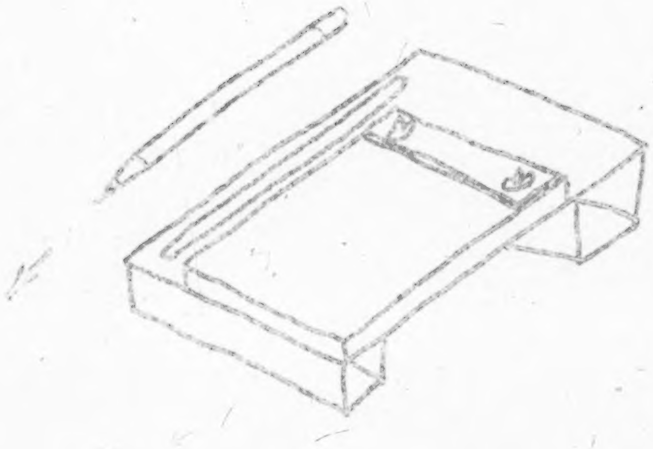


FIG. F

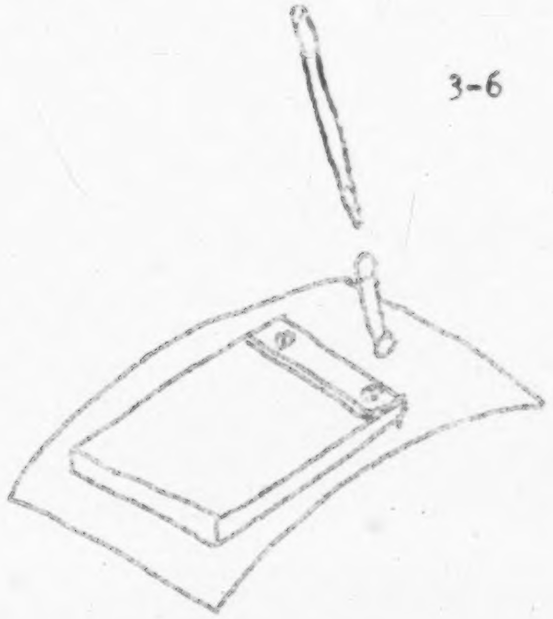


FIG. G.

FIG. F. ADVANTAGES

1. Simple construction
2. Convenient storage

FIG. F. DISADVANTAGES

1. Pencil is likely to slide from slot

FIG. G. ADVANTAGES

1. Good looks
2. Pencil stays put

FIG. G. DISADVANTAGES

1. Likely to break pencil point
2. Difficult to put pencil in holder

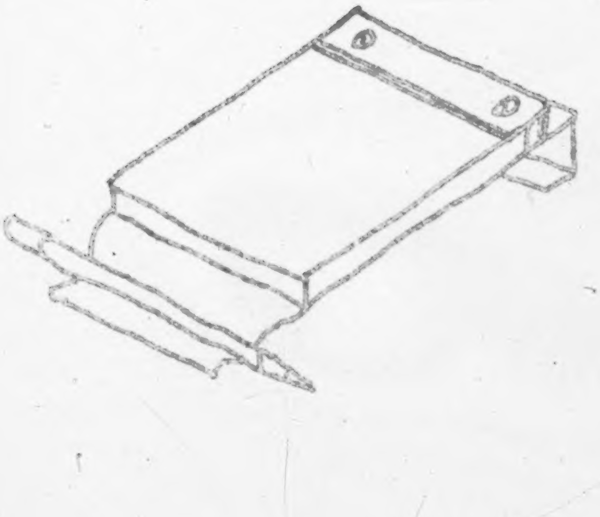


FIG. H

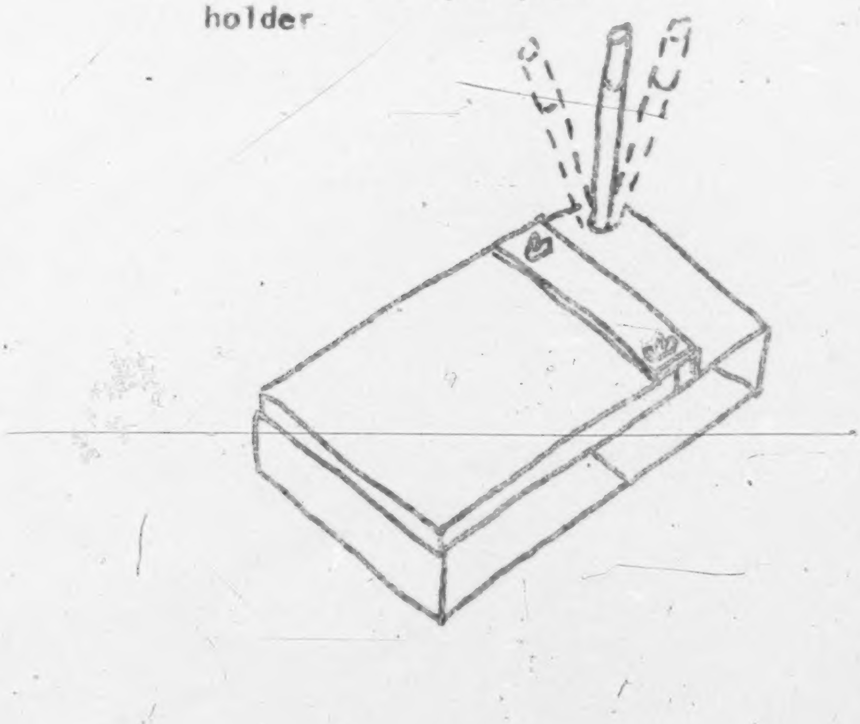


FIG. I

FIG. H. ADVANTAGES

1. Easy pencil storage
2. Good looks
3. Pencil stays put

FIG. H. DISADVANTAGES

1. Difficult construction

FIG. I. ADVANTAGES

1. Simple construction
2. Good looks

FIG. I. DISADVANTAGES

1. Likely to break pencil point
2. Pencil will not stay put

3. Pad clamp. The pad clamp should hold the writing pad tightly in place. It should not slip easily. The clamp should allow the pad to be easily changed. Let us study each of the four clamping functions. (Fig. J,K,L,M).

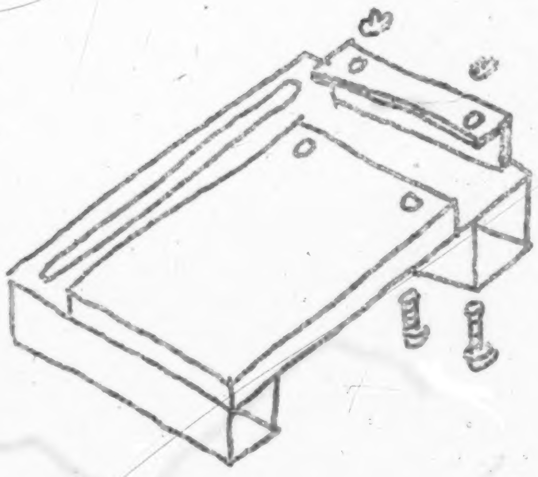


FIG. J

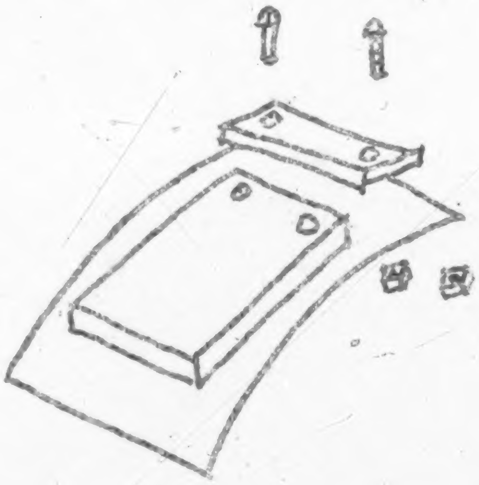


FIG. K

FIG. J. ADVANTAGES

1. Simple construction
2. Holds pad securely

FIG. J. DISADVANTAGES

1. Paper has to be punched
2. Hard to exchange pads
3. Tools required for pad change
4. Poor looks (wing nuts)

FIG. K. ADVANTAGES

1. Simple construction
2. Holds pad securely

FIG. K. DISADVANTAGES

1. Paper has to be punched
2. Hard to change pads
3. Tools required for pad change

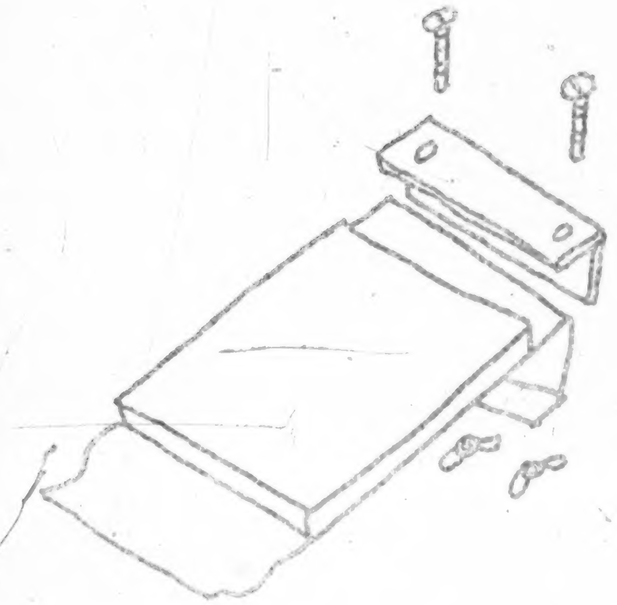


FIG. L

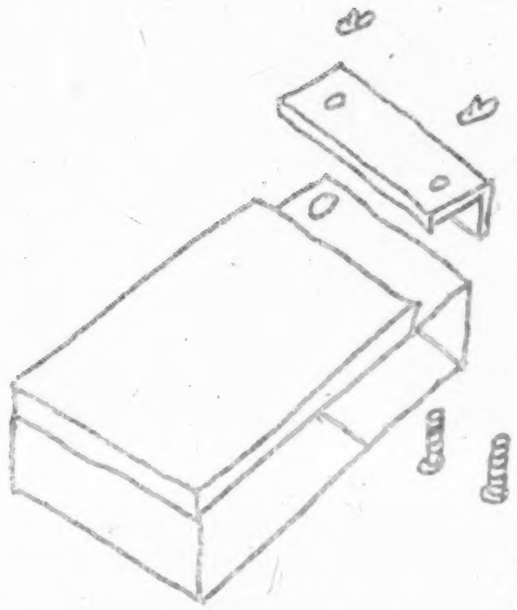


FIG. M

FIG. L. ADVANTAGES

1. Holds pad securely
2. Pads easily changed

FIG. L. DISADVANTAGES

1. Tools required for pad change

FIG. M. ADVANTAGES

1. Holds pad securely
2. Pads easily changed

FIG. M. DISADVANTAGES

1. Poor looks (wing nuts)
2. Tools required for pad change

Material requirements. The material requirements of the holder should be studied. The main problem is to choose the best kind of metal of the right thickness.

1. Choosing the metal. The designer must choose the best metal to use for the holder. The metal must be selected based on the operations the metal will go through in manufacture. One can quickly see, by a study of the chart, that the only metal that meets the specifications is steel sheet. (Fig. N).

METALS	OPERATIONS			
	Can Bend	Can Cut	Can Drill	Can Paint
Copper Sheet	Yes	Yes	Yes	No
Brass Sheet	Yes	Yes	Yes	No
Steel Sheet	Yes	Yes	Yes	Yes
Aluminum Sheet	Yes	Yes	Yes	No

FIG. N. SELECTING METAL: THE METAL MUST BE SELECTED BASED ON OPERATIONS

2. Choosing the metal thickness. The designer would select steel sheet to use for the holder. His next problem would be to select the right thickness of metal. One can quickly see, by study of the chart, that the only metal that meets the thickness and cost specifications is steel sheet. (Fig. O).

GAUGE METAL	METAL STIFFNESS	COST PER SQUARE FOOT
16 Gauge	Very High	57¢
18 Gauge	High	48¢
20 Gauge	Medium	37¢
22 Gauge	Low	30¢
24 Gauge	Very Low	25¢

FIG. O. SELECTING THICKNESS: THE METAL MUST BE SELECTED BASED ON STIFFNESS AND COST

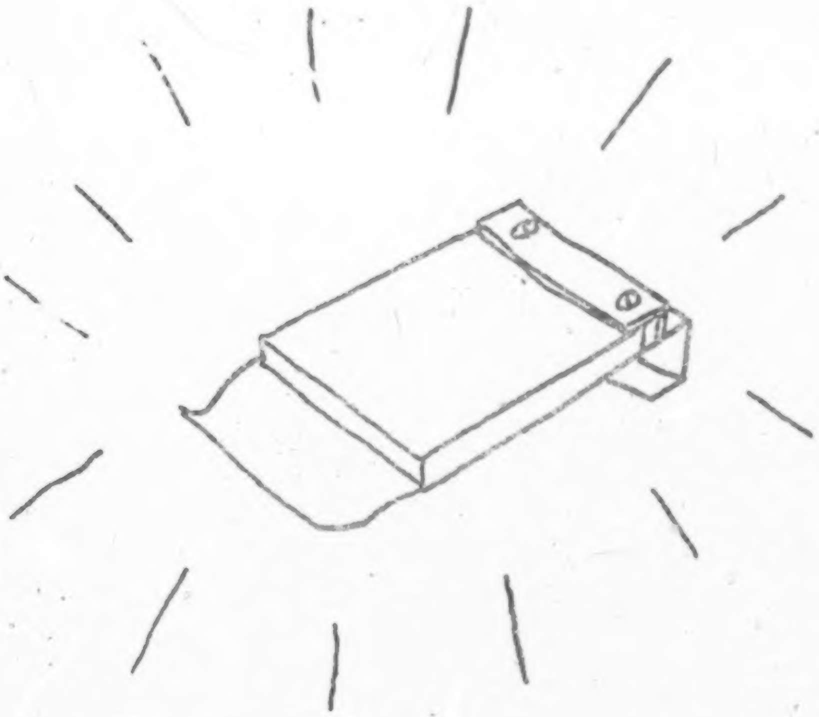
The designer wants the metal to be thick enough to support writing. No extra thickness is needed. This would be wasted material. However, he wants to keep the price of the material as low as possible.

The best choice for the note pad holder appears to be 20 gauge sheet steel.

SELECTING THE FINAL DESIGN SOLUTION

This step requires the designer to choose his best design. He would choose from his four designs. His choice must be based on the product specifications.

In making up his mind, the designer, would consider the advantages and disadvantages of each design. When he studied each design, he would probably choose the following design. It has more advantages and less disadvantages than the other designs. (Fig. P).



ADVANTAGES

1. Strong, flat writing surface
2. Does not scratch desk top
3. Good looking shape
4. Good use of materials
5. Easy pencil storage
6. Pencil stays put
7. Holds pad securely
8. Pads easily changed

DISADVANTAGES

1. Difficult construction
2. Tools required for pad change

FIG. P. FINAL DESIGN SOLUTION: The designer, based upon the best design factors, chooses his best design.

BUILDING THE PROTOTYPE

A prototype (model) should be made at this point. It would be hand made in the plant model shop. This model is necessary to make certain that everything works as planned. All production is based on this model. It is used as a pattern for manufacture. If any problems in design show up, they would be solved at this time.

MAKING DRAWINGS AND SPECIFICATIONS

The final step for the designer would be to tell the production department of his design idea. This would be done by a drawing and product specification. The drawing would tell the size and shape of the holder (Appendix III). The specifications would tell the details of the holder (Appendix II).

SUMMARY

When the designer solves his design problems he does it in a step-by-step process. The design steps are: (1) Analyzing the Product, (2) Collecting Design Solutions, (3) Testing and Experimenting with Solutions, (4) Selecting a Final Solution, (5) Building the Prototype, (6) Drawings and Specifications.

STEEL PROCESSING

OBJECTIVES

The student after studying this unit should be able to:

1. Differentiate between the blast furnace and the open-hearth furnace.
2. Understand the difference between iron and steel.
3. Understand the use of rolling mills and how they are used to make sheet steel.

INTRODUCTION

Imagine waking up tomorrow in a make-believe world without steel. It would be like living in the stone age. We have chosen steel as our product material because of its importance. It is often called the backbone of industry.

We have organized a component processing company. This means we have to use materials manufactured by other industries. It would not be economically possible for a small company like ours to start with the raw materials. In this unit we will examine specifically the primary processing industry which supplies us with steel. For a general overview of the primary processing industry, refer to the analysis section 16:1.

IRON MINING

Steel does not occur in the earth as a free metal. In fact it is obtained from iron ore. Iron ore is extracted (taken out) of the earth's surface. It is a combination of

FILMED FROM BEST AVAILABLE COPY

oxygen, minerals, and rocks. Most of the iron ore in this country comes from Minnesota, Wisconsin, and Michigan. However it is the fourth most abundant element and is found in every state and in every country of the world.

There are generally two kinds of iron ore mines. These are the pit mine and the shaft mine. The pit mine is one in which the ore lies close to the surface of the earth. The mine is nothing more than a large hole made by power shovels extracting the ore. The shaft mine is similar to a coal mine and is usually from 500 to 2500 feet deep. After the ore is mined, it is moved to a steel mill which changes it into a more useable form.

THE BLAST FURNACE

The first step in steel making is the production of iron from the iron ore. The idea is to remove the iron from the oxygen, minerals and rock. To do this the ore is heated with coke (made from coal) and limestone. When it reaches a certain temperature, oxygen and carbon combine into a gas which escapes. The iron remains in a molten state. This is called smelting and is done in a blast furnace.

Iron ore, limestone, and coke are placed in the top of the blast furnace. The limestone is used for a flux. A flux is a material which helps minerals or metals to melt. The coke is ignited (caused to burn) and blasts of hot air are blown through the air inlets. As the coke burns, the materials melt and descend to the bottom of the furnace.

During this time, the carbon from the coke combines with the oxygen from the ore and forms gases. The gases are released at the top of the furnace. As the materials continue to melt and descend, the limestone changes. It causes the impurities in the ore and coke to form a substance called slag. As these materials descend to the hearth (the bottom of the furnace) they become liquid. The coke ashes are dissolved by the slag. The slag floats to the top of the molten iron. Every four or five hours the iron is taped (taken from) the furnace. The slag is tapped more often. Once a furnace is started it usually operates around the clock until it needs repair. A large blast furnace can produce about 600 tons of iron in twenty-four hours. (Fig. A.)

PIG IRON

This first step in the blast furnace produces pig iron. Some pig iron is poured into cavities (molds) and allowed to harden. These are called pigs and weigh up to 80 pounds. The pigs are re-melted and molded into useful articles. Some of these articles are automobile cylinder heads, engine blocks and all kinds of machine parts. A large portion of the iron is moved directly to the open hearth furnace for making steel.

STEEL

Pig iron contains certain substances which must be removed or controlled by further processing to make steel.

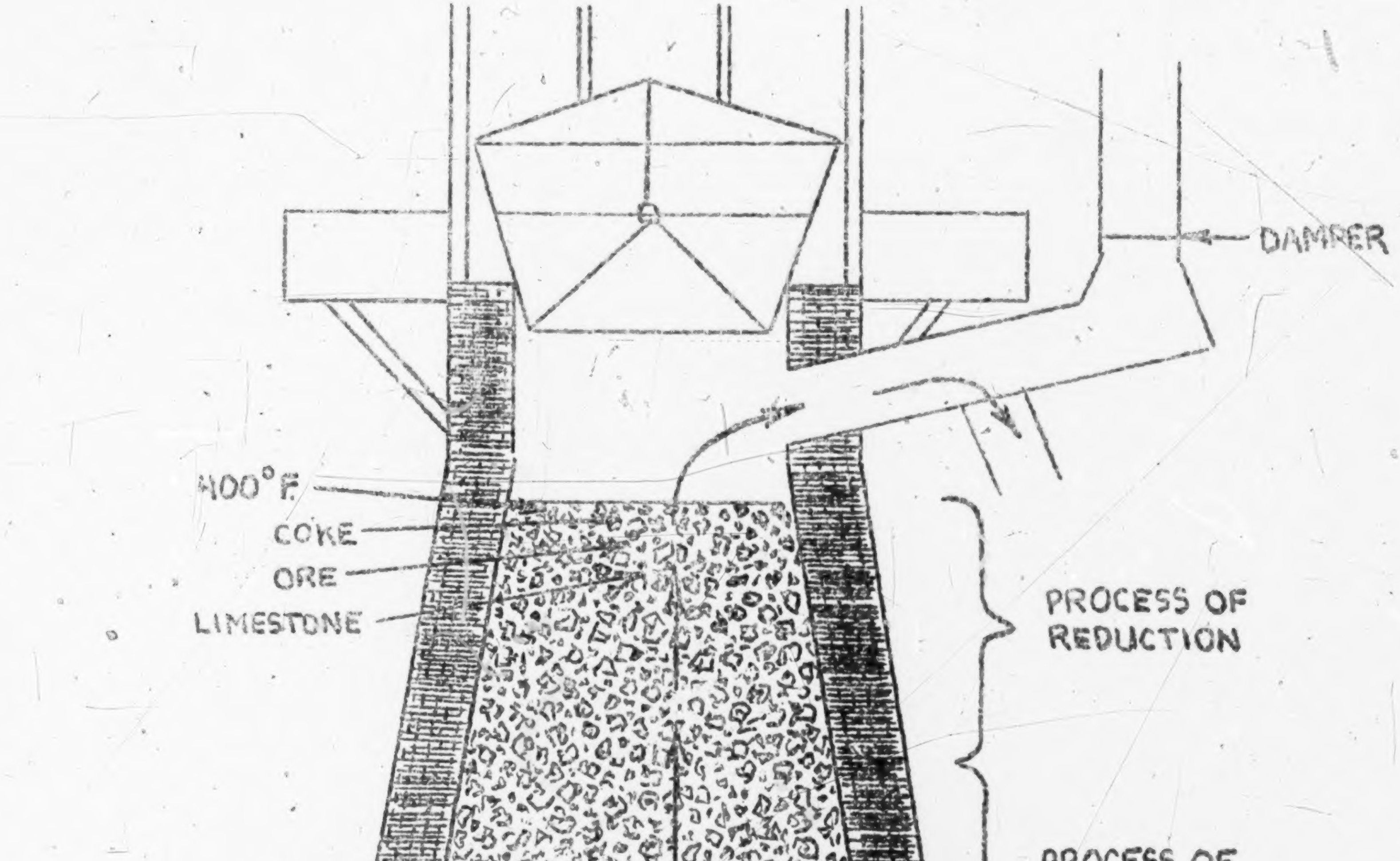

DAMPER
400°F.
COKE
ORE
LIMESTONE
PROCESS OF REDUCTION
900°F.
PROCESS OF HEAT ABSORPTION
PROCESS OF FUSION
PROCESS OF COMBUSTION
3500°F.
MOLTEN SLAG
MOLTEN IRON
HOT BLAST
HOT BLAST
IRON NOTCH

FIG. A. Blast furnace: Cut-away view showing how a blast furnace operates.

Some of the substances which pig iron contain are sulphur, phosphorous, silicon, manganese and 3.5 to 4% carbon.

Steel is an alloy. An alloy is a combination of two or more materials, the majority of which is metal. Carbon is the alloying element in steel. The carbon content of the pig iron has to be controlled to manufacture steel.

Pig iron contains about 4% carbon. This is the major substance which makes iron hard, but at the same time very brittle. Steel is normally considered a very strong material but it contains 2% carbon or less.

THE OPEN HEARTH

Most of our steel is produced in open hearth furnaces. They are large rectangular structures made of fire brick. The floor is similar to an oval dish. They are built to hold from 50 to 300 tons of steel. There are two openings at each side of the furnace. One is for fuel and the other is for air. The fuel can be gas, coal, oil, tar or a combination of these. The air and fuel are heated then blown into the furnace from the openings at one side of the furnace. The ceiling of the furnace is made so that heat is deflected down into the hearth. Smoke and gases escape through the two openings at the other side of the furnace. As the gases escape, they heat a checkerboard arrangement of bricks in a chamber beside the hearth. This is called the checker chamber. There is a checker chamber on both sides of the open hearth. About every fifteen minutes the direction of flow is reversed so that the air and fuel are blown from a hot checker chamber. By using these checker chambers to heat the air and fuel a great deal of heat is saved.

INGOTS

In the open hearth process, limestone and scrap steel are first charged (put in) into the heated furnace. Next molten pig iron is brought from the blast furnace and poured in. The molten metal boils. Limestone forms slag and comes to the top. Silicon, sulphur and phosphorous are absorbed by the slag. Carbon passes off as gas. When the right content is reached (less than 2% carbon for steel) the furnace is ready to be tapped. The metal is allowed to flow through a hole into a large ladle. The steel is now ready to be poured into molds to harden into ingots. Ingots are large metal castings weighing up to 50 tons. (Fig. B)

The ingots, after being removed from the molds, are taken to the soaking pits. Soaking pits are heating chambers where the ingots are heated red hot to a uniform temperature throughout. The ingots are then ready for further processing.

SHEET STEEL

To form sheet steel, the ingots pass through machines called rolling mills. (Fig. C.) These mills keep flattening the steel until it is the desired thickness. When this

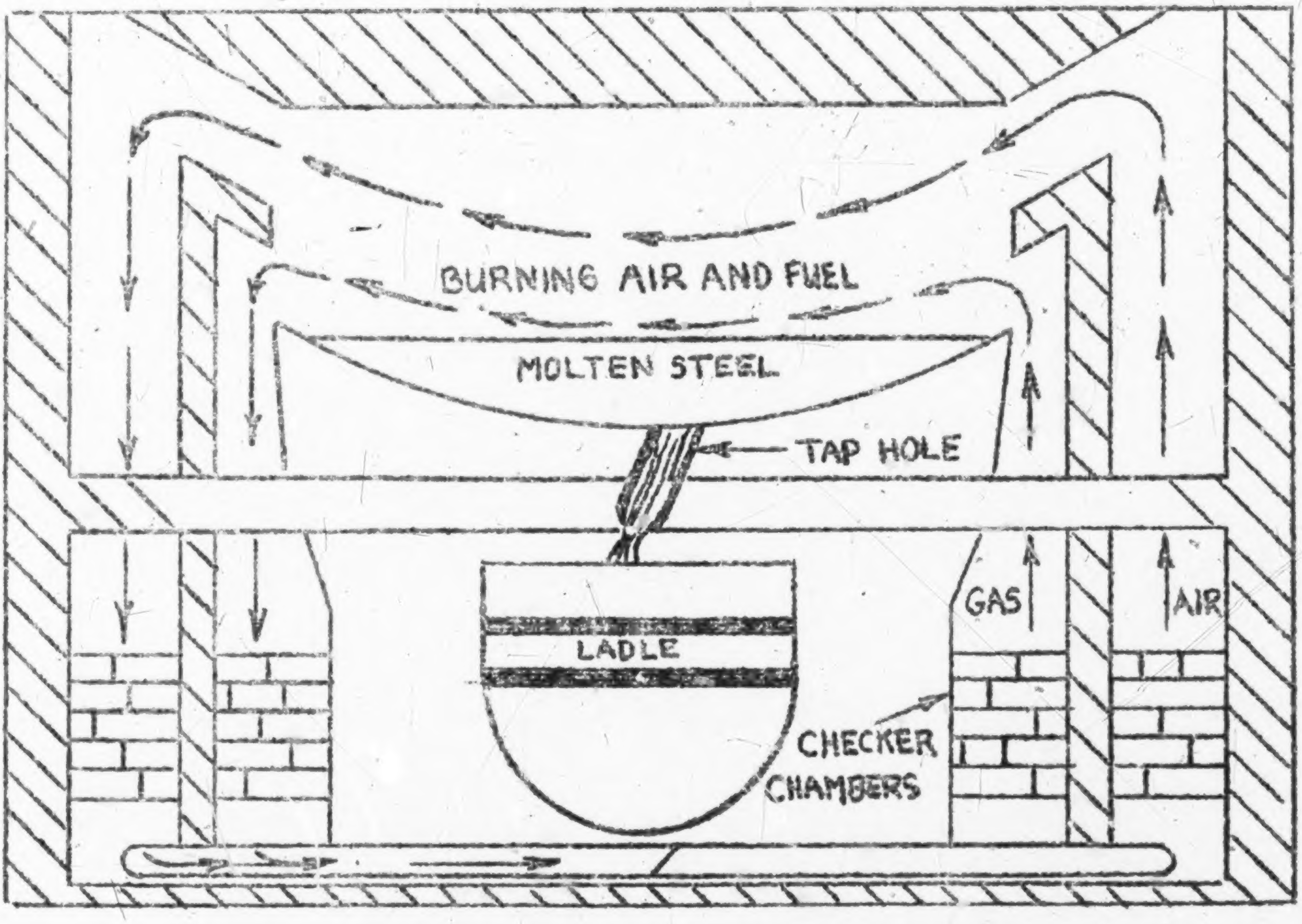

BURNING AIR AND FUEL
MOLTEN STEEL
TAP HOLE
LADLE
GAS
AIR
CHECKER CHAMBERS

FIG. B. Open-hearth furnace: Cut-away view showing checker chambers, gas flow and other details.

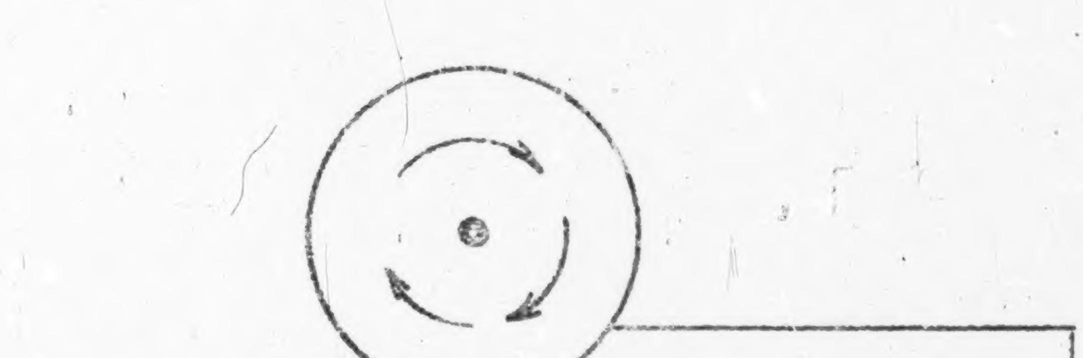


FIG. C. Rolling mill: Ingots are rolled to the desired thickness.

thickness has been reached, each ingot has been formed into a long strip. The strip is then cut to size, coiled and stored. This is hot rolled steel and is almost black in color.

Most sheet steel is later cold rolled for a better finish and greater accuracy. The hot rolled steel is unwound and bathed in sulphuric acid. It is next rinsed in cold water. This removes the scale caused by hot rolling and produces a brighter finish. This process is called pickling. Now it is ready for cold rolling to a very accurate thickness. It is then coiled again and stored for shipment.

SUMMARY

We have studied this very important raw material from iron ore to sheet steel. First the blast furnace is used to make iron from iron ore. Then the open hearth is used to make steel ingots from iron. The ingots are then rolled into steet steel. These are all primary processes (or steps) in the manufacture of the sheet steel we need for our finished product.

LABORATORY ACTIVITY

Objectives

The student,after participating in the laboratory activity should:

1. Gain a better understanding of steel making.
2. Develope a better appreciation of how steel is made in our industrial society today.

ACTIVITY

The students will view the film, "One Hoe for Kalabo" available from, Modern Talking Picture Service, 1212 Avenue of the Americas, New York City 10036 -- free except for return postage.

PRODUCTION PLANNING

OBJECTIVES

The student, studying the unit on Production Planning and setting up a production line for making note pad holders, will:

(1) Learn the Job and Operation planning steps that must be done before a production line can be "set up".

(2) Recognize the importance of fixtures, templates, and special handling equipment to an efficient production line.

(3) Understand the importance of good planning before production starts - to eliminate "bottlenecks".

(4) Learn the value of inspection (quality control) to a smooth running production line.

INTRODUCTION

Before actually going into production of the note pad holder it is necessary to do a great deal of planning and paperwork. Things such as Job Description, Material Flow, Special Equipment, Machines, Pilot Run, and Quality Control must be put down on paper. The purpose of this pre-production planning is to determine the places in actual production processes where slowdowns (bottlenecks) will be likely to happen. Corrections can be made at this point, before the production "line" is put into operation.

The main reason for doing planning of this type now is to eliminate wasted motion or unnecessary steps when we go into production. At this stage, we can also forsee what tools, machines, and special equipment (fixtures, templates, etc.) will be needed., With this knowledge, it is then posible to have these things ready, and in proper order when production actually begins. Planning these details out in advance gives us a mental picture of what to do before we actually do it. Next, a pilot run of the product through the line may show us where any mistakes have been made in the planning. A pilot run means making one note pad holder, by running the parts through the production lines we have set up. When we do this we will use the same tools, machines, fixtures, and methods to be used in actual production. We may eliminate many bottlenecks during this pilot run. Also, we may find some modifications that are needed in the product or processes.

JOB DESCRIPTION

The first thing we will need to do is list the operations necessary in making each part of the note pad holder. Two parts (components) will be made on our assembly "lines". These parts are the body (base), and the clamp. The other components (screws and nuts for assembly, and pad of paper) will be purchased. It is necessary therefore, to break down each operation into basic jobs for each part on the two "lines".

An operation breakdown will enable us to put each job into an order that will give us the best material flow through the production line. Just as in making any product, some operations must be done before others can be accomplished. The note pad holder involves the operations of layout, drilling, cutting, bending, filing, punching, finishing, and assembly.

Since there are two parts to be made, we will break down the operations for each part separately. The operations that will be done on Part A (body) are Layout, Drilling, Cutting, Filing, Bending, and Finishing. For Part B (clamp), operations include Layout, Punching, Filing, Bending, and Finishing. Each of these operations is made up of one or more "jobs". For example, Layout of the body involves seven (7) different jobs, or proceedures.

First, we list the general operations, and then place them into an order that will enable us to make each part as quickly and as well as posible. Then we can break down the operations into various jobs. The job breakdown will then give us clues as to what tools, machines, and special devices we will need. (For example, it shows us how many templates we will need, and what kind of fixtures we will have to build.) By breaking down the different jobs, we can also help other departments, such as training, by showing what will need to be included in their training programs.

However, the main benifits of breaking down these operations and jobs is still to aid in cutting down confusion along the "production line". We want each part to flow stedily along from one job, or work station to the next -- without any bottlenecks. Pre-planning, in the form of Job Description Sheets help us do this. (Fig. A) The entire

5:4

description may be found in the Appendix (Fig. V & VI)

JOB DESCRIPTION
PART A (Base)

JOB	DESCRIPTION	EQUIPMENT
1. Layout ink application	1.(a)Apply layout ink to stock	1. Shoe polish applicator
2. Layout holes	2.(a)Position part in holder (b)Position template #1 (c)Mark holes	2. Material holder Template #1 Scriber
	3.(a)Position par	

FIG. A Job Description: Example of part of a job description sheet.

MATERIAL FLOW

Production line operation will be used for making the note pad holder foe several reasons. First, by having a number of work stations (jobs) close together, it allows a worker to "specialize" in doing one job. He will be able to do his job faster, better, and with less training. He will then pass the part along to the next work station. Stations being close together will cut down on worker travel time to move parts between stations (handling).

Between major operations, such as Layout and Drilling, that are separated by a rather large distance, we will use stock boxes and "runners". (Fig. B) For example, the man who does the last operation in Layout will put his material into a stock box. When the drill press operator needs more stock, a stock runner will bring one of these boxes of material from the layout line.

5:5

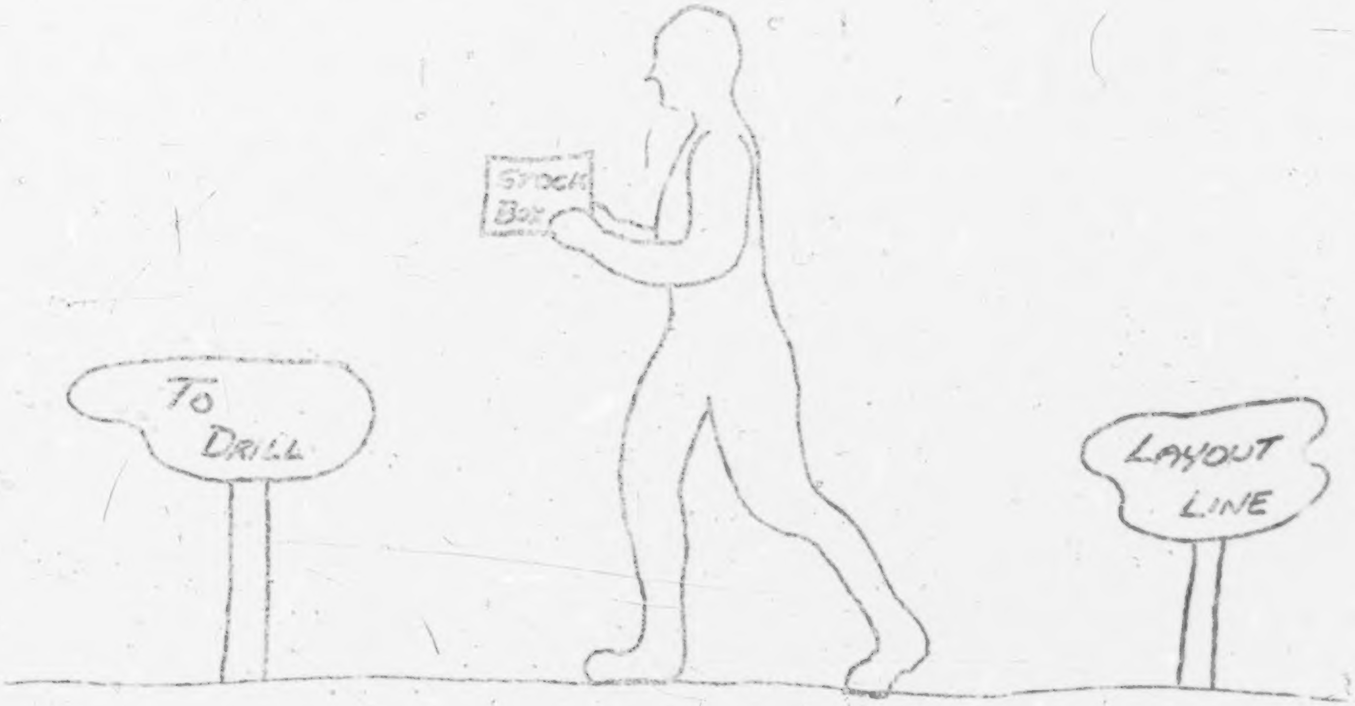


FIG. B Stock Runner: Worker that takes stock from the end of one "line", or operation to the next job.

To find places along the line that we will need stock boxes, materials, tools, and templates we will need to make out a Material Flow Chart. (Appendix VII) We will use the Job and Operation Breakdown charts to help set up (on paper) a flow chart to show how parts will progress along the production line.

After we have set up this flow chart we will then have to arrange our line to fit the shop. That is, arrange the stations in the order that we have listed to get the best flow. Then we will modify it in relation to our benches, and "fixed equipment" (drill press, box and pan brake, and other machines). With this down on paper, we will be able to see if any further change in the order of operations or "flow" will help make our two lines more efficient. (Fig. C) The entire chart is in the appendix (Fig. VIII).

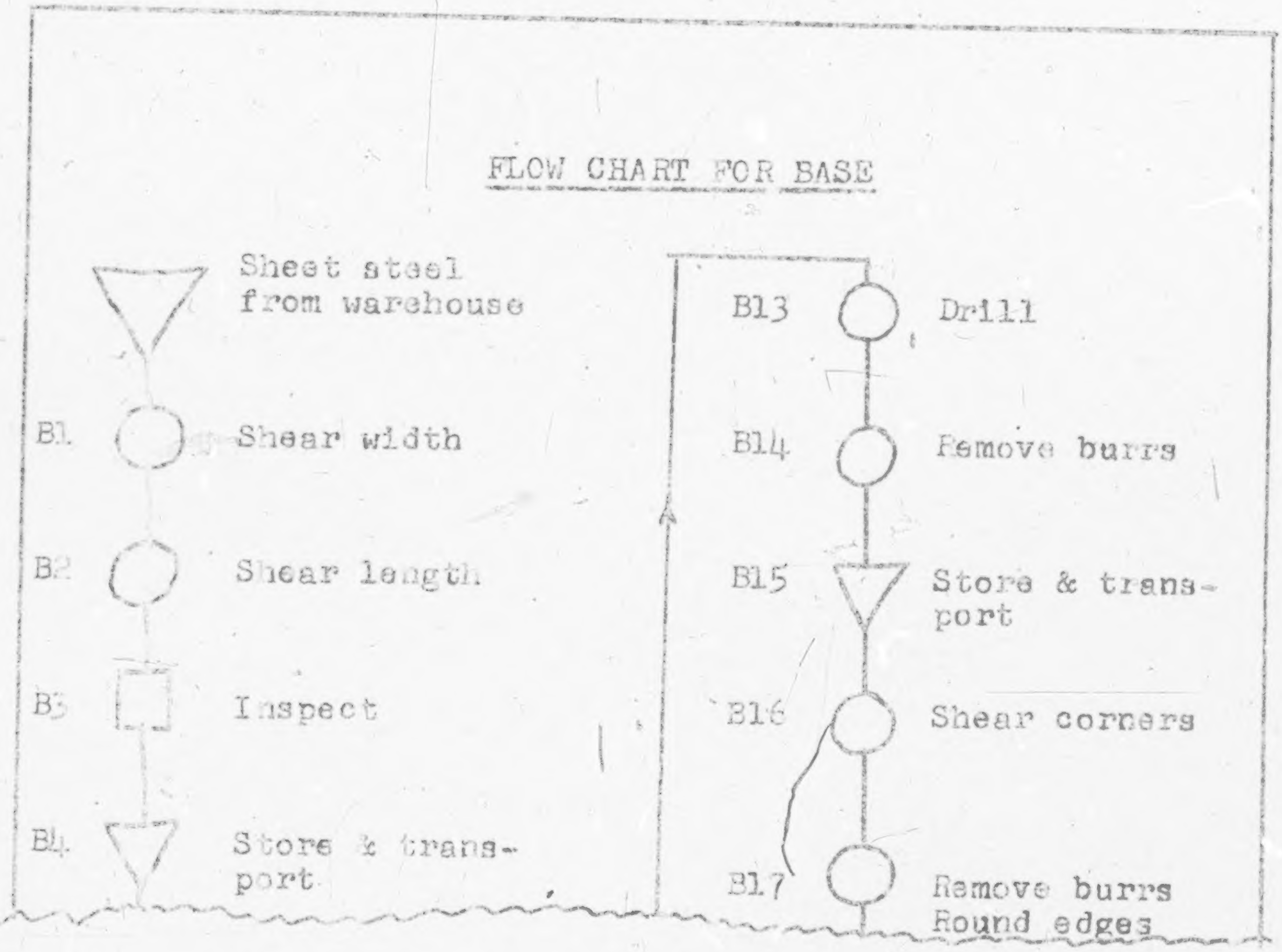

FLOW CHART FOR BASE
Sheet steel from warehouse
B1
Shear width
B2
Shear length
B3
Inspect
B4
Store & transport
B13
Drill
B14
Remove burrs
B15
Store & transport
B16
Shear corners
B17
Remove burrs
Round edges

FIG. C Flow Chart For Base: Example of part of the flow chart for the production line.

SPECIAL EQUIPMENT

By using the Job Description sheets, we can make a listing of the special equipment we will need to produce the note pad holder. (Appendix X) Special equipment means things such as templates, fixtures, stock boxes, and material holders. These are things that help production line people make their work more effecient. For example, templates are patterns which the worker marks around in laying out such things as holes and bends in the pad holder (Fig. D). Fixtures are devices to hold and locate work for various operations like drilling, marking, or inspection.

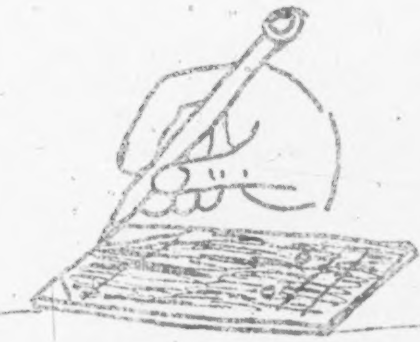


FIG. D Template: Marking around the template with a scriber.

The use of these aids to the line worker does several things to help production. Using templates reduces the number of tools and motions used by each person in the layout section of the line. Just picking up tools and putting them down takes a great amount of time when a large number of pieces are to be made. Along with this, using templates reduces the skill level that is needed for each operation. For example, by using templates, it is not necessary to measure each bend and hole of the body. The worker just positions a pattern over the stock and marks around it.

The extent of making special equipment, and the material they are made from will depend a lot upon how many note pads are to be made. If we were going to produce thousands of our product, it would pay to make the fixtures out of metal so they would last longer. Since we are only going to make 50 pad holders, we will construct our fixtures from wood, with metal locating pins. This cuts down on expense and time involved in making the equipment. The templates can be made from sheet metal because they do not take much time to cut out, are cheap, and last longer than cardboard or other similar material.

MACHINES

Fixtures, templates, and other special equipment will help speed up material flow along the production line. However, these things must be used and arranged with regard to where "fixed equipment" is located in the shop. Fixed equipment refers to things such as the Drill Press, Box and Pan Brake, Bar Folder, Shear, and Tables. These are things, not easily moved, that are necessary in the production of the note pad holder.

Since these machines and tables are more or less stationary, it will be necessary to plan the production line around them. To do this, we will make a rough sketch of our work area. This sketch will show the location of the fixed equipment. The rest of the tools and production aids (fixtures, templates, tools) can then be located on the sketch.

Just as before, the number of a product to be made will determine how much moving of equipment needs to be done. We are only making 50 note pad holders, so it would not pay to re-arrange our equipment. The production line will be planned around the machines to get best material flow (Fig. E).

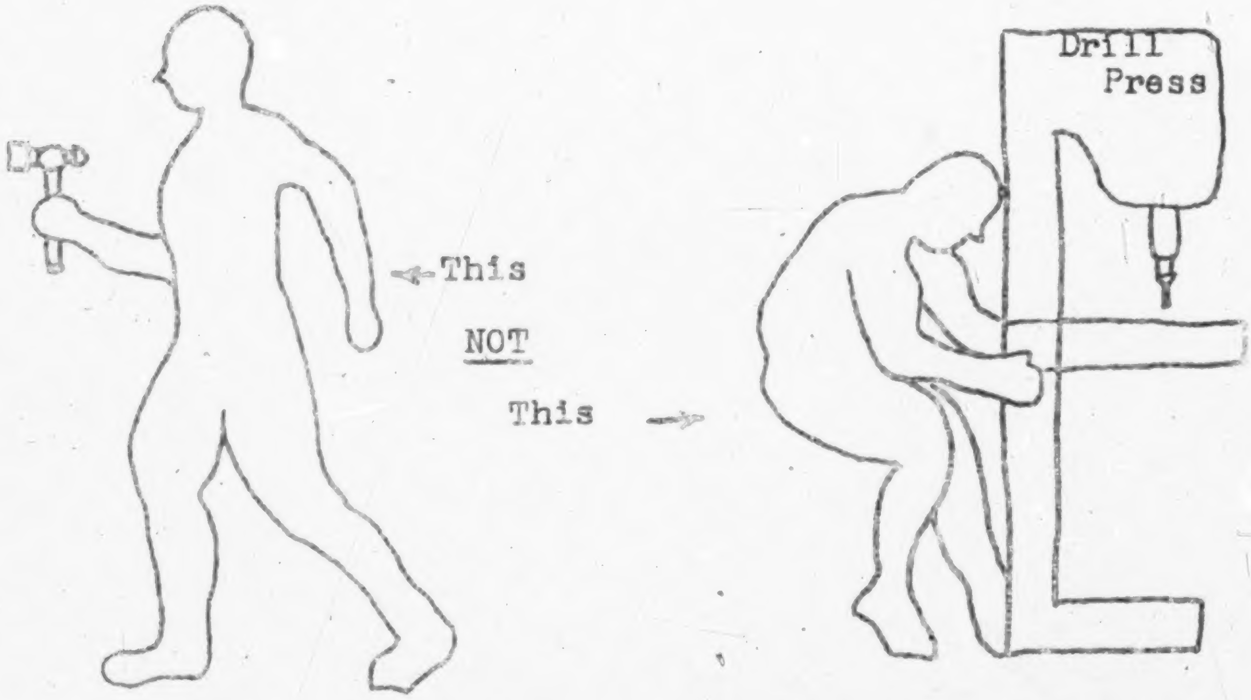


FIG. E Arrangement of Production Line: Where posible, re-arrange tools and production aids around "fixed equipment".

PILOT RUN

Now we are ready to see if all of the paperwork and planning is going to pay off when we start actual production. We are now going to make a "pilot model" (prototype) of our product. This means we will make one note pad holder, using the production line we have set up. Doing this, we can check the operations, special equipment, machines, and tools to see if the pre-production planning was correct.

As the pilot model goes through the line, we will note any adjustments that need to be made. The production processes will be tried at this point to see if job descriptions are "O.K.". This will help Personnel in setting up the training program. A time check will be run to see where bottlenecks are, and to eliminate them. If modifications in design are needed they will be noted, and changes made. Finally, after all the "bugs" are worked out, we are ready to put the production lines into operation. (Fig. F)

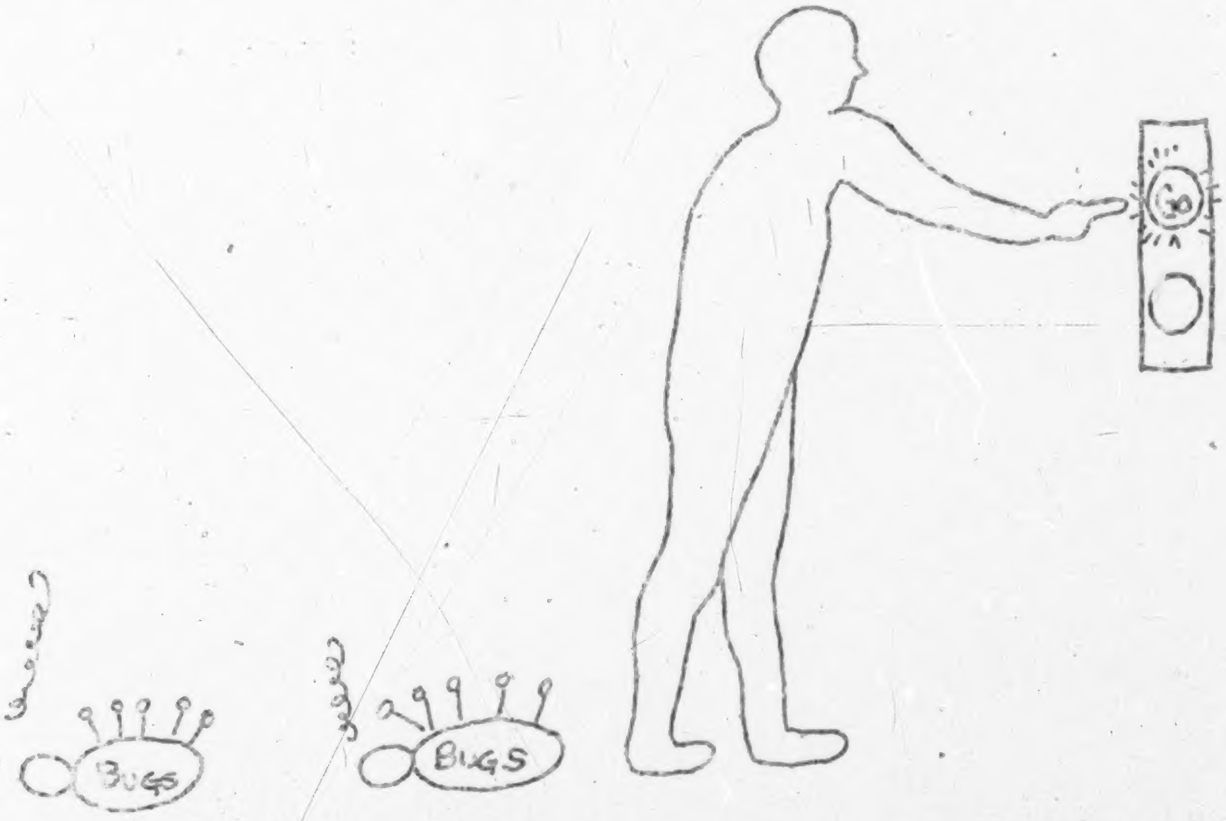


FIG. F Start Production: After the "bugs" are worked out in the pilot run, then production line goes into operation.

QUALITY CONTROL

The note pad holder that leaves the end of our production line must be of the highest quality. Also, as the parts move along the line, each job must be done correctly. For example, if the holes are not placed or drilled properly the two parts cannot be assembled. This would cause a tie-up at the assembly work station. This, in turn, would cause a back up all along the line. As a result, production would finally stop.

To prevent a bottleneck of this type, we will inspect each part at various points along the line. The parts must be checked to see if each one is like the others. In other words they must be interchangeable. Flaws in workmanship and faulty parts have to be caught and corrected before the part is allowed to move along the line.

We will use three different methods for checking. At some points, only a visual check will be used. (Actually, the parts are being visually checked all the time) In the case of inspection after the bending operations we will visually check the body to see if it looks like the body model. Another check is made by measuring the part. For example, the body bend lines are measured with a steel rule. The other inspection method we will use on our product is by template. The template is placed over a part to check hole placement, cutoffs' marked in the right places, and bends in the correct spots.

If any problems are found during these inspections, they must be taken care of at once. The part may be sent back to the proper work station for correction (recycled).

The inspector may be able to quickly make minor repairs himself. Sometimes it may be necessary to stop production and make an adjustment along the production line. If all else fails, the part will be scrapped. In no case will a part that does not "measure up" be allowed to pass on. (Fig. G)

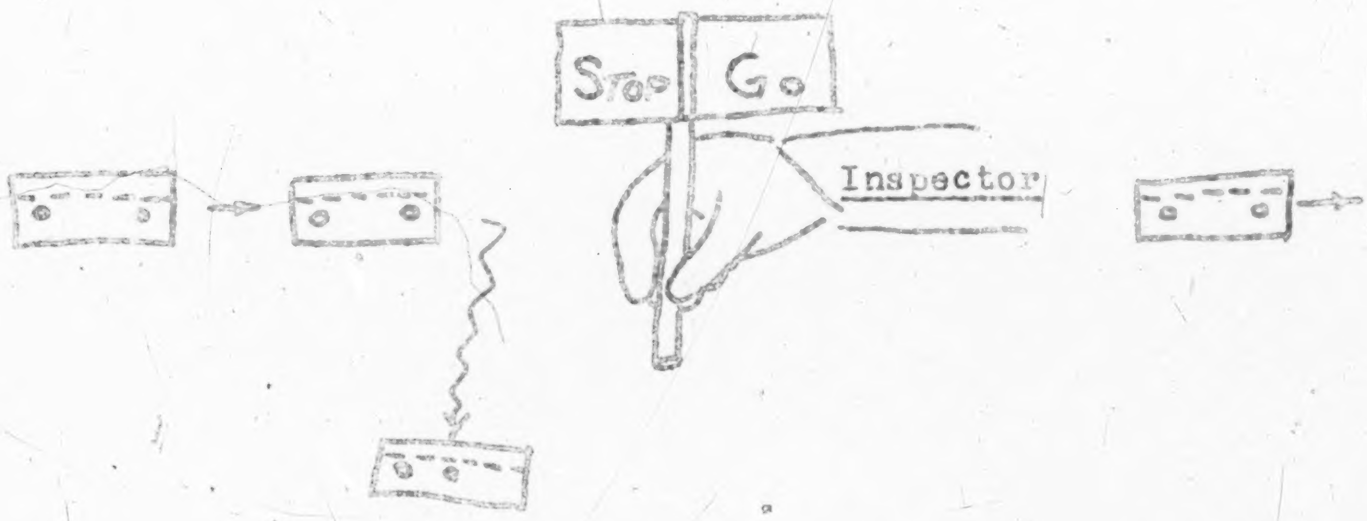


FIG. G Inspection: Good parts are allowed to pass on, bad parts are rejected.

SUMMARY

Good production planning will eliminate most of the production problems and bottlenecks before production actually starts. By breaking down Jobs and Operations in making the note pad holder we will be able to plan many things that will make our production faster and more effecient.

Special equipment can be constructed in advance, and be ready when we start to work. The production lines can be set up with regard to existing equipment in the shop.

The best lines of flow for making parts can be set up. All of these things are made posible by good pre-production planning. Then a pilot run will allow us to iron out the remaining trouble spots.

After we start production, inspection (quality control) will insure us that the line will continue to operate smoothly. Careful inspection also means that the parts which come off the end of the line are of the highest quality. It is therefore necessary, in the planning, to carefully place inspection points along the line to insure this high quality.

All of the above considerations go together to help our production line operate at top efficiency, and produce an excellent product.

FINISHING & ASSEMBLY

OBJECTIVES

The student should be able to:

1. Give two reasons why a metal part is finished.
2. Name three different ways to finish metal parts.
3. Give four ways to cover a part with paint.
4. Name five mistakes a good painter avoids.
5. Give the best way to fasten metal parts which must later be taken apart.

INTRODUCTION

Many people like the bright and shiny appearance of the natural metal finish. However, most metal parts do not continue to keep their bright, shiny appearance. After a short time the metal begins to tarnish (become dull) and then rusts. The rusting not only spoils the appearance but also causes the metal to deteriorate (grow worse). Neither the man who manufactures or the man who uses a rusting product is happy about it. The rusting product is soon discarded. (Fig. A). Therefore, a finish is put on the metal to stop rust from forming and to make the surface look even better.

Following the finishing process is the job of assembly or fastening. There are many fast^e^ners made for holding metal parts together. But for certain jobs some fasteners are better than others. When the parts

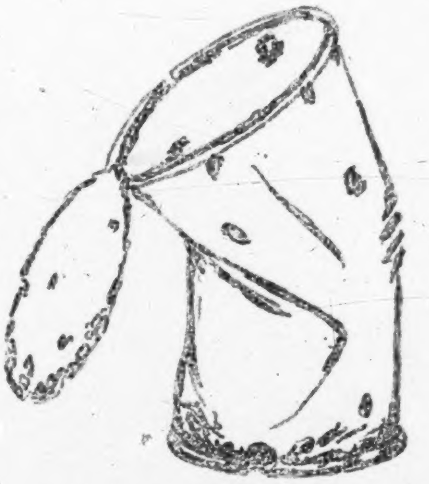


FIG A Rusting: The rusting product is soon discarded.

must be loosened later, screws and nuts have been found to be best. The frames of roller skates are held with screws and nuts. (Fig. B). The clamp and base of our note pad holder will be held with screws and nuts.

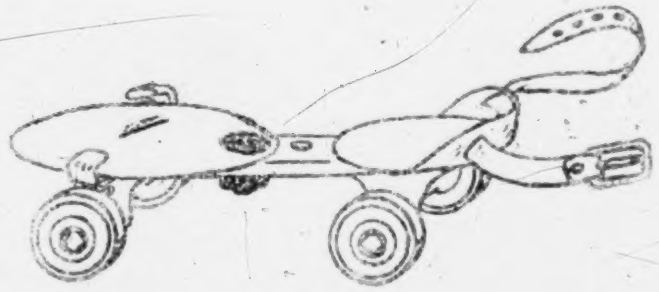


FIG. B Assembly: Roller skates are held with screws and nuts.

COMMON FINISHES

Three common methods of finishing have been used on metal products. Each of these methods involve coating the metal with something which will not rust.

1. The cheapest method is to wipe oil or grease over the surface. You may have put oil on a bicycle chain or grease on the wheel bearings. Why would a coating of oil or grease be unsuitable for a note pad holder?
2. The most difficult method is to plate the product with a metal which will not rust. Automobile bumpers, bicycle spokes and handle bars are usually plated with chromium. The screws and nuts used to hold the note pad holder together could be plated. Manufacturers would rather use another method because of the trouble, danger, and high cost of plating.
3. The most used method is to cover the metal with paint or a similar material. Automobile bodies, bicycle frames, kitchen stoves, and many other products are finished by this method. The note pad holder will be painted because it is easy, good looking, and not too costly.

PREPARING FOR FINISH

An important step for a good finish is to provide a smooth, clean surface. Any rough areas on the surface can be removed by rubbing with a pad of steel wool. (Fig. C). Any dust, smears, or fingerprints should also be removed by wiping with a rag. Some of the stubborn spots might need a liquid (waterlike) cleaner added to the rag. Oleum, which is noninflammable, makes a good and a safe liquid cleaner. After cleaning and before painting, each part should be thoroughly inspected. Any part which is not acceptable should be put either into the tray for rework or the tray for rejected scrap. Acceptable parts with smooth, clean surfaces are taken to the painter.

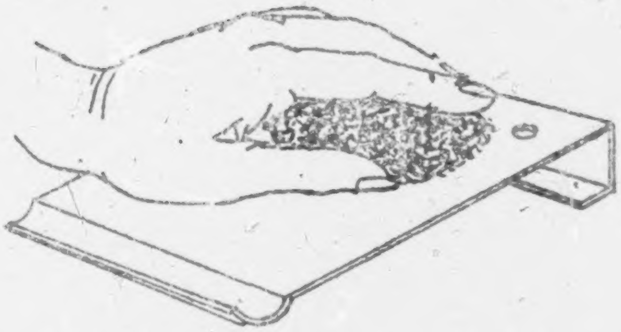


FIG. C Preparing for finish: Any rough areas can be removed by rubbing with a pad of fine steel wool.

PAINTING METHODS

Paint can be applied with a brush. (Fig. D). But brushing is slow, leaves marks and hairs, and requires careful cleaning. The quickest method of coating is by dipping in the can. (Fig. E). After dipping, the product is hung

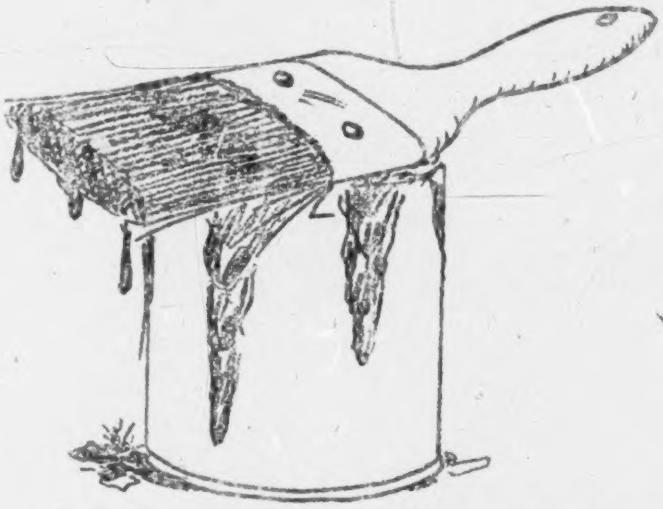


FIG. D Brushing: Paint can be applied with a brush.

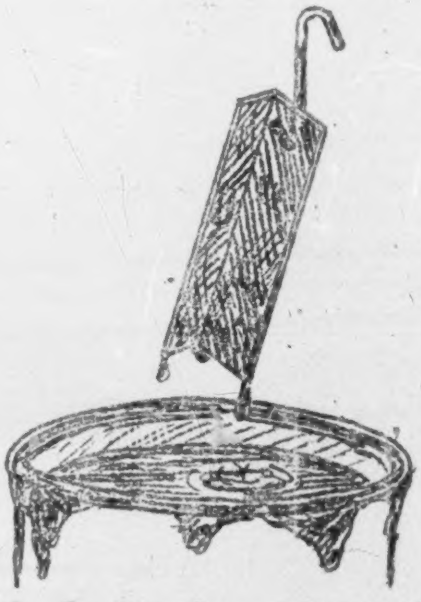


FIG. E Dipping: The quickest method of coating is by dipping in the can.

up to drip dry. Dipping is messy, wasteful, and does not coat evenly. Paint can be applied with a roller, but this is not suitable for small or odd-shaped products. (Fig. F). Most manufacturers apply paint and other liquid finishes by spraying (making the paint misty). (Fig. G). Small products are easy to paint with pressure spray cans when regular spray equipment is not available. The note pad holder will be painted with a pressure spray can.

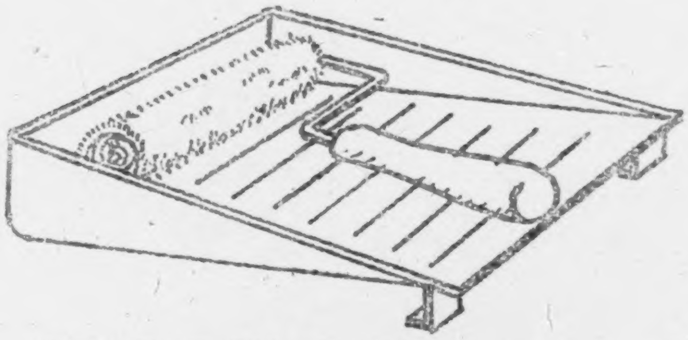


FIG. F Rolling: Paint can be applied with a roller.

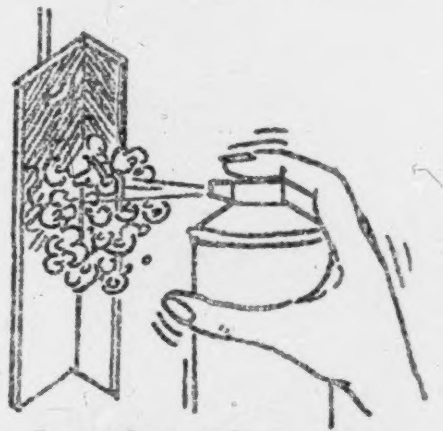


FIG. G. Spraying: Most manufacturers apply paint by spraying.

PAINTING THE NOTE PAD HOLDER

In order to prevent applying the wrong color of paint to our parts, the clamp and base will be painted in different booths. The clamp will be painted gray and the base will be crimson. However, each painter will follow the same order of procedure. The part to be painted is suspended by the hook in the spray booth. (Appendix XI). The can of paint is stirred by shaking it until the ball on the inside rattles freely. The paint is applied by passing the can back and forth in front of the part, depressing the button on top to release the paint. The spraying continues until the part is coated evenly all over. It might be necessary to turn the hook in order to reach the back side. A good painter is one who will not:

1. Hold the spray in one spot, forgetting to move it.
2. Move the spray too fast or too slow.
3. Have the spray too close or too far away.
4. Waste the paint by spraying past the part.
5. Spray something besides the part. (Fig. H).
6. Smear the fresh paint on the product.

The freshly painted part must be moved carefully by its hook to the drying rack for storage. (Appendix XI). As the spray booth is emptied, another part can be hung in place and painted in the same manner. When the last part has been painted, the hole in the spray can is cleaned by inverting the can and touching the button briefly. (Fig. I). The safety cap may be put on the top of the can after cleaning to prevent touching the button accidently.

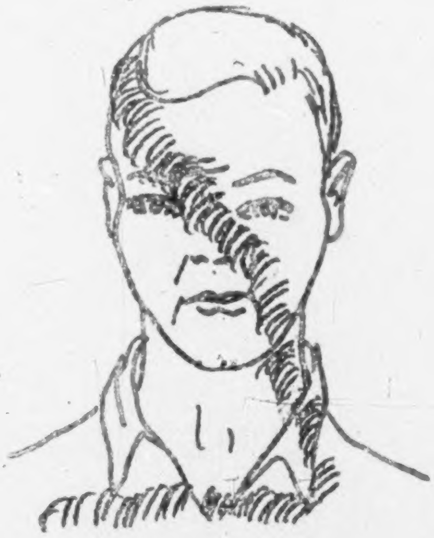


FIG. H Spray painting: A good painter does not spray something besides the part.

ASSEMBLY

Large or complicated parts must have special holders called fixtures to position them during assembly. However, small and simple parts like the note pad holder can be held in the hands

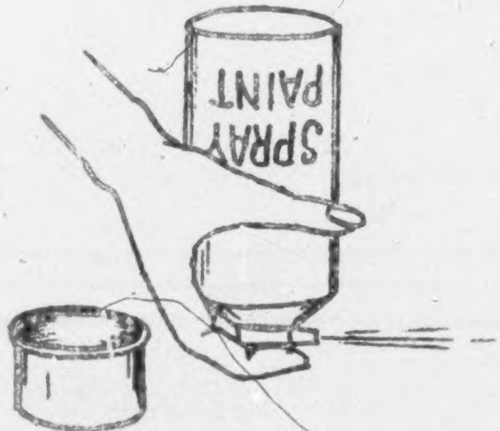


FIG.-I Cleaning: The hole in the spray can is cleaned by inverting the can and touching the button briefly.

during assembly. Some fasteners require tools for tightening but our screws and wing nuts can be assembled without tools. The parts are arranged so they can be reached easily. The screws are pushed through the clamp and the base, and the wing nuts are started on the threads. (Fig. J) Take care because the edge of the metal may still be sharp. Also, remember to turn the nuts clockwise (same as the hands on a clock) to tighten. Place the pad between the clamp and the base, hold the screw down to keep it from turning, and finish tightening the wing nuts. (Fig. K). Inspect the finished assembly. If any part is defective (faulty), it should be put in the tray for rework or the tray for rejected scrap. Acceptable assemblies can be sent to finished storage.

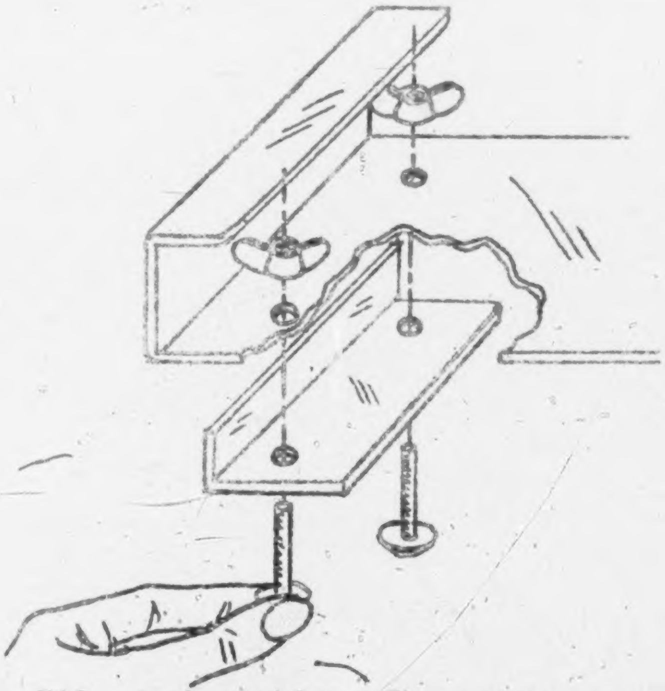


FIG. J Assembly: The screws are pushed through the clamp and the base and the wing nuts are started on the threads.

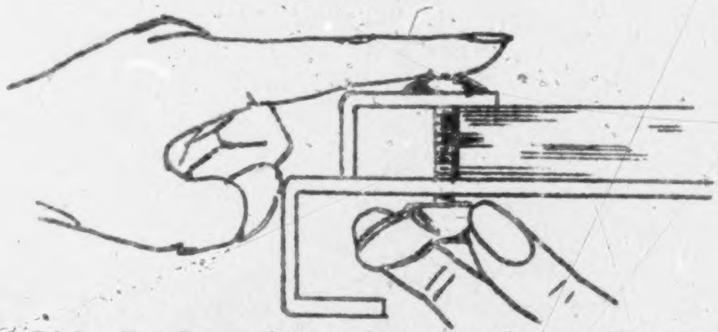


FIG. K Assembly: Place the pad between the clamp and the base, hold the screw down to keep it from turning, and finish tightening the wind nuts.

SUMMARY

Metal components are finished to stop rust from forming and to make the surface look even better. Three common methods of finishing are oiling, plating, and painting. Painting is widely used in manufacturing because it is easy, good looking, and not too costly. Before painting the metal surface must be smooth and clean. Most manufacturers apply paint and other liquids with spray paint equipment. The note pad holder should be painted with a pressure spray can in a special booth. The note pad holder is assembled with screws and wing nuts without the use of tools. Faulty parts are separated for rework or rejected scrap.

PRODUCTION PERSONNEL

OBJECTIVES

The student, after being part of the production personnel work, will be able to:

1. Understand the value of good workers in industry.
2. Understand the processes of hiring personnel for industrial jobs.
3. Realize why industry needs to formulate a personnel policy.

INTRODUCTION

People are the most important factor in modern production. Machines and tools are of no value unless properly operated by efficient personnel.

The policy of the company is efficiency on the production line. All rules and regulations affecting factory personnel are to be set up by the personnel department in conjunction with the management.

The working conditions will be very good and there will be a union contract in force. The production line and methods of operation will be pre-determined by management. The teacher after training demonstrations and safety instructions, the beginner student should be ready to start production.

PRODUCTION PERSONNEL

To enable the company to properly select the workers, all class members will complete an application form, a sample of which is in the appendix page XV. The completing of the application should be a part of the interviewing session.

Interview Procedure

1. The applicant should be allowed sufficient time to complete the application form.
2. The interview should be performed in a friendly atmosphere and must be considered a serious industrial type function.
3. The interviewer should show a genuine interest in the applicant and encourage him to talk, so as to learn more about him.

The job descriptions will be made up by the production department. The personnel department will use these as guide lines when hiring new workers. Each person will learn more than one job as a rotation system will be set up.

For the production of the note pad holder, the company will require the following operational people, or semi-skilled personnel.

Drill press operators
Box and pan brake operators
Bar folder operators
Squaring shears operators
Special jig benders

Other semi-skilled personnel needed are inspectors, who check the quality of the work performed on the note pad holders, and finishers to paint the completed production item.

The following is a list of job positions to be filled by unskilled laborers.

Inkers
Scribers
Center punchers
Hand drillers
Hand punchers
Filers
Hammerers

Additional unskilled workers will be needed for receiving, handling, and storing materials. Handlers will be needed to keep the materials moving well on the production line. A clean-up crew is always necessary.

Training of Production Personnel

The training of production workers will be done by the teacher, who will demonstrate the machine operations and tool function. Inspectors should be properly trained so they will recognize possible defects in the note pad holder during the production and assembly processes.

The production item is made of sheet steel. Therefore, safety will be a very important part of the training. Safety devices and safety psychology will be constantly needed. Production personnel are to be indoctrinated with safety practices. They will be followed from the beginning planning stages and throughout the entire production.

Sheet Metal Work Safety

General

1. Keep the work area free of slippery cutting.
2. Avoid sliding sheet metal through the hands.
3. When riveting, chiseling, grooving or hand punching, strike the tool squarely with the hammer.
4. Beware of corners and edges protruding into aisles where workers pass.
5. Keep fingers clear of the mouth of machines when closing down on the metal.
6. Keep fingers out of the pinch area as the metal is bent.
7. Concentrate on the job and avoid distractions.

Squaring Shear

1. Keep fingers clear of the blade and never under the hold-down bar.
2. To avoid crushing toes, keep feet clear of the pedal.
3. Use care in handling sheared razor sharp metal.
4. Never cut excessively small pieces on shear. Use hand snips.

Box and Pan Brake

1. Use care when inserting or removing sharp edged sheets.
2. Keep fingers clear of the mouth of the machine when closing down on the metal.

Bar Folder

1. Keep fingers out of the pinch area as the metal is bent.
2. Use care when inserting sharp edged metal.

Drill Press

1. Be familiar with all switches and levers that are used to operate the machine.
2. Watch out for loose clothing, so there is no chance of becoming entangled with rotating drill.
3. Use safety guards and hold downs.
4. Permit the drill to stop of its own accord, after power has been turned off.

WAGES

Personnel and management should decide on a wage system. This could mean finding out from the local industry what wages are paid for the jobs that correspond to our production of the note pad.

It could be setting wages in relation to level of the job performed. A set wage rate for semi-skilled and slightly lower one for unskilled.

The time card would have to be kept up to date by each worker. Each day it should be turned into personnel.

A sample of a time card is included in the appendix page XVI.

SUMMARY

In industry, a great amount of planning and organization is necessary before the workers have a job on the production line. The potential employee must be interviewed, hired, instructed to do the job, and taught the various safety practices. Only after these procedures are followed efficiently can production go forward.

LABORATORY ACTIVITY

Objectives

The student after participating in this activity, should realize how important safety is in mass production.

Materials

1. Card board 4" by 6" or 8" by 12"
2. Crayons or colored felt pens
3. Rulers
4. String

Procedures

Using crayons or colored felt pens, the student makes up safety posters or machines safety signs. The string is to be used to hang the poster or sign in an appropriate place.

MATERIALS HANDLING

OBJECTIVES

The student, after studying this unit, will understand:

1. The steps of ordering materials for the note pad holder.
2. How bills of material are used.
3. How the quantity of the order is determined.
4. How to lay out parts for the note pad holders on standard-sized raw materials with a minimum of waste.
5. The importance of writing specifications carefully.
6. How to receive, store, and protect materials used for the note pad holder.
7. How a production flow chart is used to manufacture note pad holders; and the symbols used on the production flow chart.
8. What materials-handling operations are needed for each processing line.
9. How materials-handling equipment improves the efficiency of the flow of materials.
10. The need to keep rework and scrap pieces separate from good parts.
11. Safety practices for storing and handling the materials used to make the note pad holder.

INTRODUCTION

The company, Manufacturing, Inc., was formed to produce note pad holders. Money was raised to finance the production of the holders. The note pad holder was designed. Drawings and material specifications for producing the holder have been developed. Special tools, templates, jigs, and fixtures needed to make the holder are being made. Production operations have been described. Men are being hired and trained to do the production operations. Yet, the note pad holder cannot be manufactured until the right raw materials are brought to the factory.

Some of the materials needed for the note pad holder are already available. Others must be purchased. The company will lose money if the men and machines are not kept busy. In order to keep men and machines busy, a supply of materials should arrive before the production run. To make sure that the supply is available and doesn't run out, a Purchasing Department is needed. The Purchasing Department must determine how much material to order. The amount is determined using a bill of materials, shop drawings, and information from Marketing Research. From this information, a purchase order is made.

When purchases are received at the factory, they must be handled efficiently. The flow of materials through the factory must be controlled. The materials must not be wasted. Neither should men or machine time be wasted while waiting on materials. The cost of handling the materials should be kept as low as possible. The second part of this unit is about pre-processing (receiving, storing, and protecting) materials for the note pad holder.

The flow of materials from the storeroom to the end of the assembly line is a third important part of materials handling. In order to plan the flow of materials, a plant layout must be made. A flow chart will be useful for this phase of planning. Materials-handling equipment will be needed to move materials efficiently.

PURCHASING

As soon as the design is approved, the Design Department must make a bill of materials. The bill of materials is a list of the materials needed to make one note pad holder. The bill of materials is sent to the Purchasing Department (Appendix IV).

Purchasing also receives copies of shop drawings and specifications from the Engineering Department (Appendixes II and III). The shop drawings show the shape of the note pad holder. They also show how the holder is put together.

Marketing Research has predicted that the company will be able to sell 50 note pad holders. The Board of Directors has approved the production of 50 holders. Purchasing will need this information to make an order for materials.

With the information from Design, Engineering, and Marketing Research, the Purchasing Department is almost ready to order materials. Before making the order, a check is made to see if any of the raw materials are already in stock (stored in the plant). The check indicates that enough rags are already available. All other materials must be ordered. The amount of each material needed for 50 holders must be determined. When the amount is determined, an order (called a purchase order) is sent to a vendor (a primary processing company which produces raw materials for other manufacturers).

DETERMINING HOW MUCH TO ORDER

Customarily, more material will have to be ordered than is actually used in the note pad holders. Extra materials must be ordered for two reasons. First, the steel sheet is supplied in standard-sized pieces measuring 24" x 96". When it is cut into clamps and bases, some material will be left over. Second, there is apt to be some damaged or scrap work on the production line. In order to be sure that there will be enough good bases and clamps, extra pieces are made. These extra pieces are an allowance for damaged and rejected parts.

For the note pad holder, it is estimated that an 8 per cent allowance will be needed for bases (50 x .08 = 4). A 10 per cent allowance will be needed for the clamps (50 x .10 = 5). Fifty-four bases and fifty-five clamps will be needed.

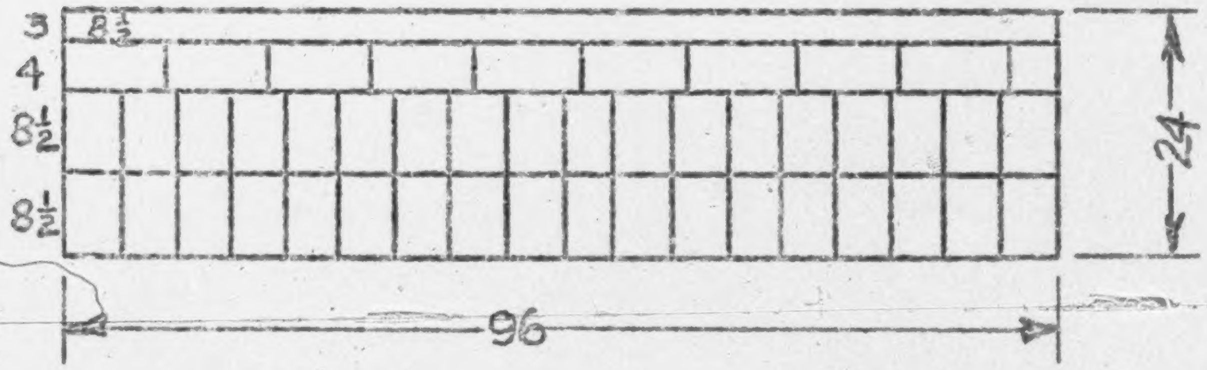
The bill of material calls for twenty gauge sheet steel. Twenty gauge sheet steel is sold in standard sheets 24" wide and 96" long. In order to find out how many sheets to order, the area of the clamps and bases must be found. Area is found by multiplying the length by the width of each piece.

The bases measure 4" x 8½". The area of one base is 34 square inches (4 x 8½ = 34). The area of fifty-four bases is 1836 square inches (54 x 34 = 1836).

The clamps measure 1¼" x 4". The area of one clamp is 5 square inches (1¼ x 4 = 5). The area of fifty-five clamps is 275 square inches (55 x 5 = 275).

The total area of clamps and bases is 2111 square inches (1836 + 275 = 2111). The area of one sheet of steel is 2304 square inches (24 x 96 = 2304). Since the area of one sheet (2304) is larger than the total area of clamps and bases (2111), only one sheet of steel should be needed.

Before deciding to buy just one sheet, a cutting plan should be developed. The cutting plan will tell whether or not all of the pieces can be cut from one sheet. A poor layout would not allow all of the bases to be cut from one sheet (Fig. A).



This layout would be very difficult to cut.

FIG. A. CUTTING PLAN: This layout is a poor one. All of the bases could not be cut from one sheet if this layout is used.

A good layout will have less waste (Fig. B).

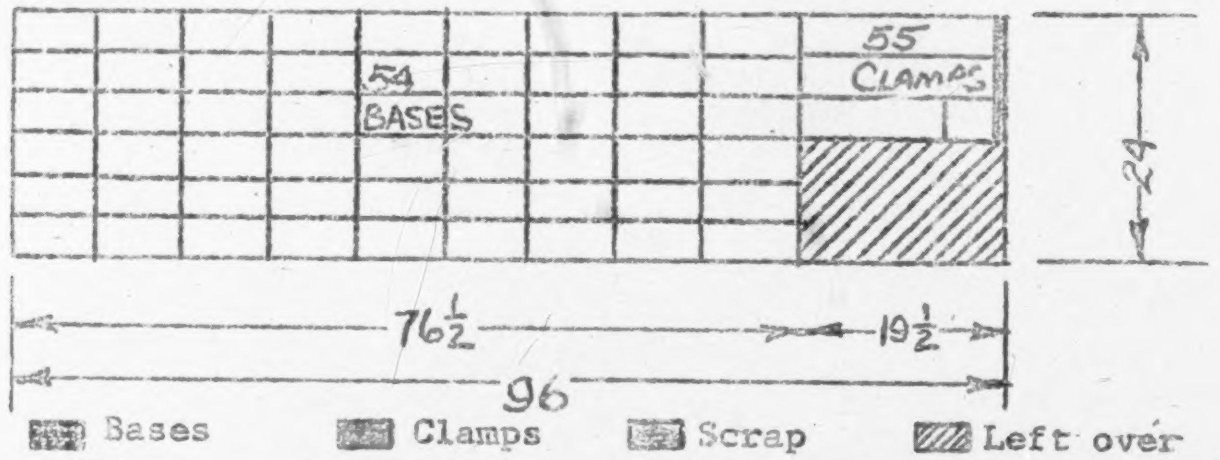


FIG. B. CUTTING PLAN: This layout is efficient. All of the clamps and bases can be cut from one sheet with some material left over.

The machine screws used to manufacture the note pad holder are standard items. They have been inspected before they leave the vendor. If none of the screws are lost, a quantity of 100 should be enough for 50 note pad holders. Wing nuts are also standard items. One-hundred wing nuts should be enough for 50 note pad holders. The note pads are standard items made by another company. If inspected properly, 50 note pads should be enough for 50 holders.

The paint catalog states that one can of spray paint will spray one coat over 750 square inches. The bases will be painted gray. Both sides will be painted. Therefore, the area to be painted gray is 3664 square inches (1832 x 2 = 3664). Five cans of gray spray paint will be needed to paint the bases (3664 ÷ 750 = 5).

The clamps will be painted scarlet. Both sides of the clamps will also be painted. The area of the clamps to be painted is 550 square inches (275 x 2 = 550). One can of scarlet paint should paint all of the clamps one coat.

WRITING SPECIFICATIONS

The Design and Engineering Departments were careful to choose the right materials for the note pad holders. The quantity of material needed as well as the cost was considered. The specifications (accurate description) for the materials must be communicated to the vendor in order to receive the right materials.

Often a purchase order is sent to several companies for bids. A bid is an agreement made by the vendor to supply specified materials at a certain cost. The bidding companies will need to know exactly what kind and quality of material is needed in order to bid.

Therefore, the purchase order should state very carefully the exact specifications for each material.

THE PURCHASE ORDER

The purchase order lists the amount of materials needed, with allowances, to make 50 note pad holders (Appendix XIV). The purchase order lists the quantity of each material needed. A stock number is used to identify the particular kind of material supplied by the vendor. The cost for each item is estimated and included on the purchase order.

RECEIVING RAW MATERIALS

When the order is received by Manufacturing, Inc., it must be checked in by a receiving clerk. The receiving clerk counts the number of pieces in the order to see that it is complete. He should check to see that the right materials were shipped. The thickness of the steel sheet should be measured with a gauge. Visual inspection should tell if the steel is cold rolled sheet. The size of the sheet should be noted.

The color number on the cans of paint must be correct. The number of cans of each color must be right.

The number, kind, and size of machine screws and wing nuts should be checked.

Materials should be inspected for damage. Scratched, rusty, or bent steel will not produce high quality note pad holders. Damaged or missing parts should be noted on the receipt form. If the materials are not useable, they must be returned to the vendor.

STORING AND PROTECTING MATERIALS

The materials used for the note pad holders will not be stored long. They should, however, be stored properly to keep them in good condition.

The steel sheet should be stored where it will not be scratched. It must be kept dry to prevent rust. The steel sheet must also be protected from being bent.

Paint should be stored in closed metal cabinets. Paint is flammable (burns easily). Therefore, it should be stored away from where fire is used.

The screws and wing nuts are small items. They must be stored in a place where they will not be lost. The wing nuts must be protected from rust. They must not be allowed to get wet.

Rags and cleaners are also flammable. They too, must be stored in closed metal containers (Appendix XI). The containers must be kept out of fire areas.

Note pads should be protected from dirt and moisture.

The items ordered for note pad holders should be marked. Marking allows the stock clerk to keep track of what the materials are to be used for. Marking should prevent the materials from being used for the wrong product.

FLOW OF MATERIALS

A production flow chart is used to analyze the movement of materials through the production line. The use of standard flow chart symbols makes the flow chart easier to read (Fig. C).

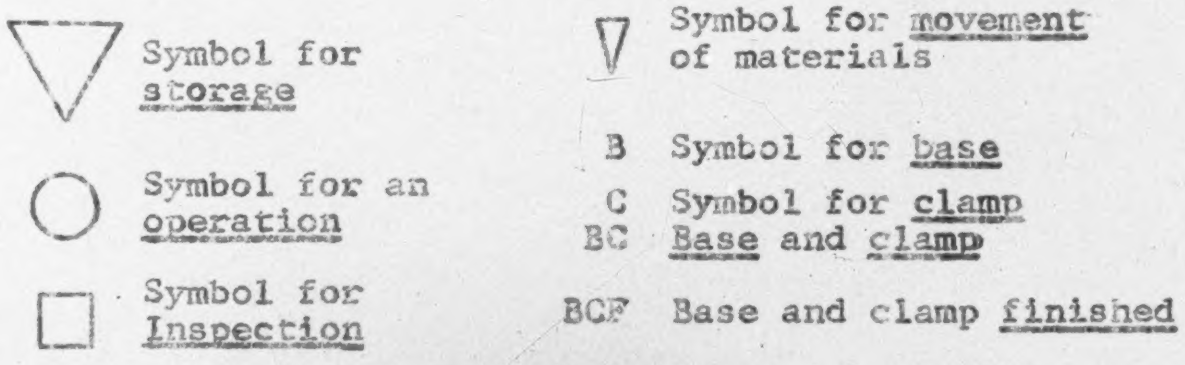

Symbol for storage
Symbol for movement of materials
B Symbol for base
Symbol for an operation
C Symbol for clamp
BC Base and clamp
Symbol for Inspection
BCF Base and clamp finished

FIG. C. FLOW CHART SYMBOLS: Symbols make the chart easier to read.

The Manufacturing, Inc., flow chart shows a flow of four basic lines in the factory (Appendix VIII). One line produces bases. Another line produces clamps. The finish line paints the clamps and bases. The assembly line puts the painted bases, clamps, and a note pad together.

THE PLANT LAYOUT

A sketch of the shop layout, indicating machines and work areas for all operations, should be made to determine the most efficient materials handling procedures. Traffic patterns should be drawn on the sketch using arrows.

The efficiency of handling materials for the note pad holder will be improved by following these suggestions.

1. Mark and label materials at each station so they do not get mixed up (Fig. D).

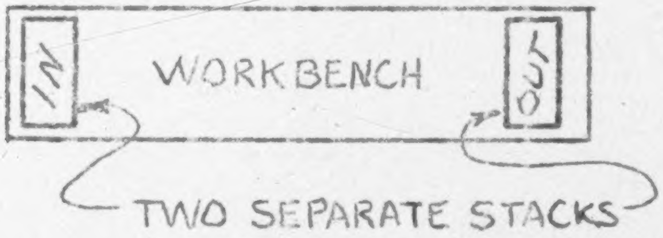


FIG. D. LABELING INCOMING AND OUTGOING PARTS: Labeling prevents mixups of parts.

2. Move materials as fast as possible but do not run.
3. Carry loads both ways if possible.
4. Group loads in stacks or in boxes.
5. Move loads over the shortest distance possible.
6. Avoid changes in direction. Have one path for going and another for coming. This will help prevent collisions.

THE FLOW CHART

Some groups of operations are done at one place in the shop. For example, several layout operations are done at one work bench. The persons doing the layout operations move the materials from one layout to the next. When materials must be moved between benches or between machines, special materials handlers are needed. At first, the handlers will need to carry only a few pieces at a time. This will get materials to all operations faster.

The flow chart shows the following materials-handling needs:

Base Production Line (Appendix VIII)

1. Move sheet steel from stockroom to shear. Two persons will be needed. Handlers should wear leather gloves to protect their hands from getting cut.
2. At B4, the cut bases should be stacked and carried to the layout table.
3. At B 13, pieces must be carried to the drill press.
4. At B 16, drilled pieces must be carried to the shear.
5. At B20, bases must be carried to the box and pan brake for bending.
6. After B25, bent pieces should be carried to the finishing line for cleaning.

Clamp Production Line

1. Move sheet steel from the stock room to shear.
2. At C4, move clamp blanks from the shear to the layout table.
3. At C13, move clamp blanks to the box and pan brake.
4. At C15, move clamps to the finishing line.

Finishing Line

1. The finishing line must be supplied with steel wool, rags, cleaner, and paint. Paint hooks and drying racks are also needed (Appendix XI). The paint hooks and drying racks are pieces of materials handling equipment.

2. When the paint is dry, clamps and bases should be moved to the assembly line. Hooks and storage racks should be put away or dismantled.

Assembly Line

1. The assembly line must be supplied with machine screws, wing nuts, and pads. All of these materials come directly from the supply room. Painted bases and clamps are brought to the assembly line from the finishing line.

2. Finished note pad holders must be protected from damage and stored until they are distributed.

Personnel will need to supply men to do the materials handling operations. The number of students in the class will determine the number of material handlers. As in the processing of the materials, some persons must do more than one job.

One person should be assigned the job of production controller. The production controller watches each line to see that materials are flowing smoothly. He assigns material handlers jobs as the need arrises. Production controlling may be done by the receiving clerk after the raw materials are checked in.

MATERIALS HANDLING EQUIPMENT

Since Manufacturing, Incorporated, is producing only a small number of products (50), it will not pay to spend a great amount of money for handling equipment. Some very simple equipment can be devised to make handling of materials more efficient.

One of the more useful pieces of materials handling equipment is a tote box or tote tray (Appendix XI). The tote tray allows the handler to carry several pieces of steel safely. Note pad holder parts can be stacked on the tray when the inspection operation is finished. Neatly stacked materials in a tote tray make it easier for production operators to pick up materials. Tote trays also keep materials separate.

There is less chance of spilling and fire if the liquid cleaner is kept in a safety container (Appendix XI).

Closed metal containers will be needed for storing used cleaning rags (Appendix XI).

Marked tote trays or buckets should be provided at each inspection station for rejected scrap and rework parts. Such containers will help keep bad parts from being mixed with good parts. The scrap materials can be carried directly to the store room. Rework materials (materials that can be fixed) should be carried to a separate department. Scrap containers will also be needed at the shear for sheared corners. Keeping the floor cleared of small pieces of metal near the shear is a good safety practice.

SUMMARY

The Purchasing Department is responsible for making raw materials available to the factory.

A bill of material is needed to make up an order. The Purchasing Department must know how many note holders are to be made. Shop drawings are useful in determining cutting plans. Cutting plans help determine the amount of raw materials to be ordered. Allowances must be made for waste and scrap.

Specifications must be written carefully to assure receipt of quality materials.

Orders should be checked carefully when received. The quality and quantity of materials should be checked. Materials should be inspected for damage.

When materials are stored, they must be protected from damage. It is important to mark items to make them easy to locate. Marking also prevents the material from being used for the wrong product. Safety must be practiced when storing flammable paints, cleaners, and rags.

Flow charts are useful for analyzing movement of materials in a factory. The note pad holder has four basic lines. The clamp and base lines must be supplied with steel. The finishing line must be supplied with steel wool, rags, cleaner, clamps, and bases. The assembly line must be supplied with painted clamps and bases. Wing nuts, screws, and pads must also be supplied to the assembly line.

Materials handling equipment should be simple for small quantity production. Tote trays will help keep parts separate. Tote trays also aid the operator in picking up and stacking materials.

A Production Controller is needed to keep the flow of materials moving smoothly. Personnel will assign men to handle materials in accordance with the number of students in the class.

BIBLIOGRAPHY

Broom, H. N. Production Management Homewood, Illinois: Richard D. Irwin, Inc., 1957.

APPENDIX I

CERTIFICATE OF STOCK

PAR VALUE ______ MANUFACTURING, INC. SEAL STOCK NUMBER ______

______________________________ OWNS ONE SHARE OF

COMMON STOCK IN MANUFACTURING, INC.

KEEP THIS STOCK CERTIFICATE FOR REDEMPTION

THIS STOCK IS TRANSFERABLE

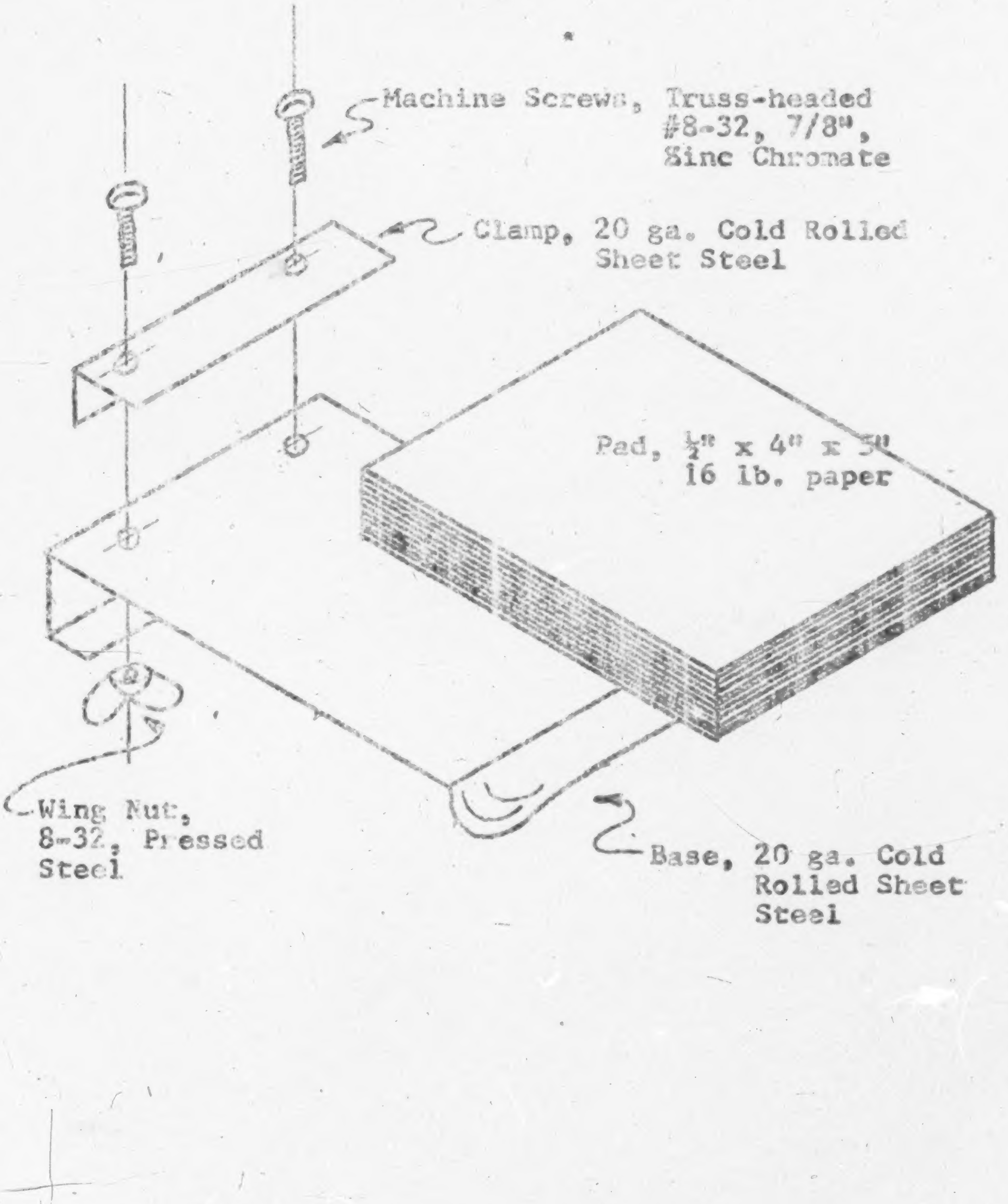
____
CHAIRMAN OF THE BOARD

DATE FROM ______ TO ______

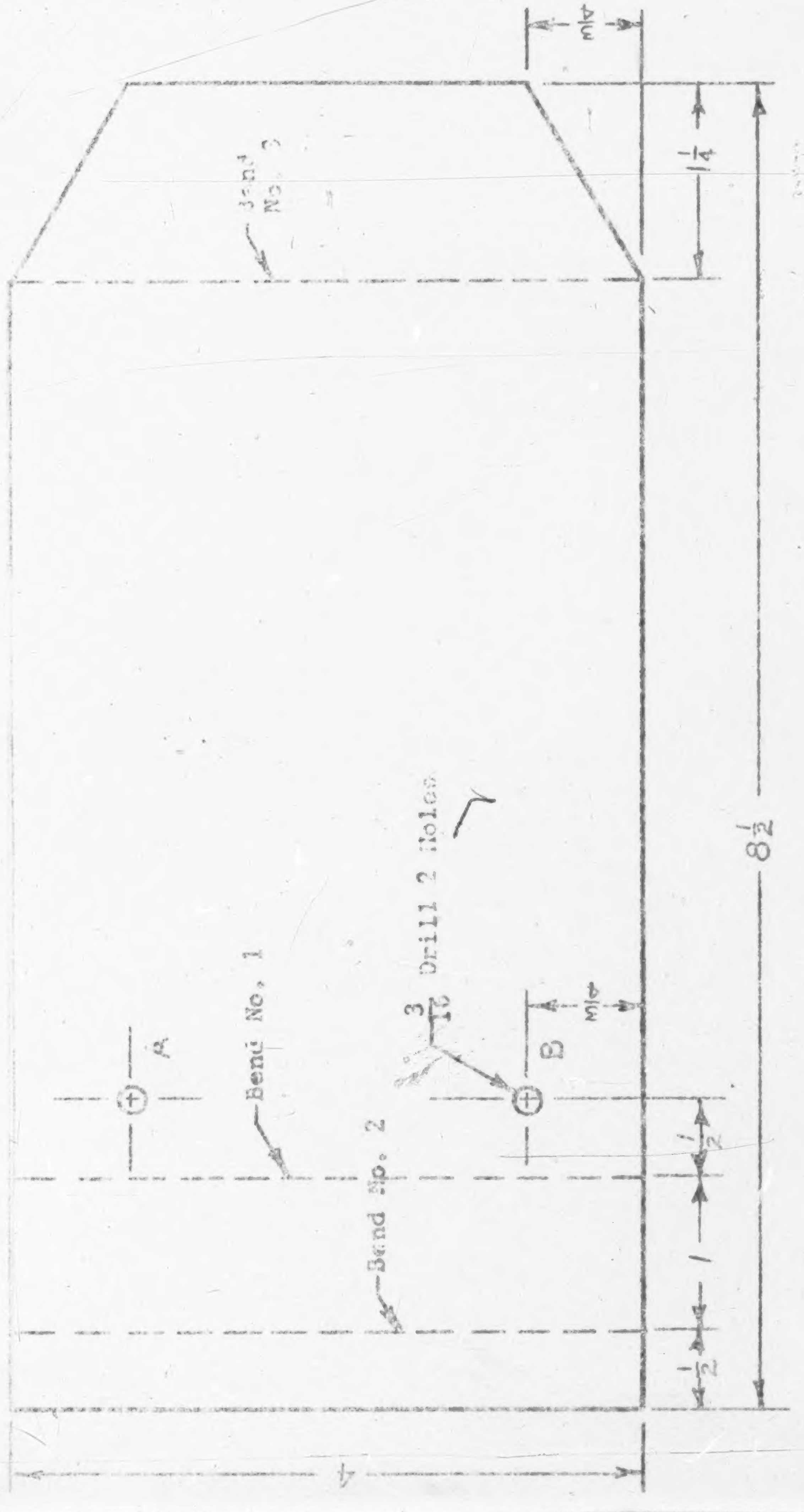
ITEM	INCOME	DEBIT
TOTAL		

APPENDIX II

ASSEMBLY DRAWING OF NPH67


Machine Screws, Truss-headed #8-32, 7/8", Zinc Chromate
Clamp, 20 ga. Cold Rolled Sheet Steel
Pad, ½" x 4" x 5" 16 lb. paper
Wing Nut, 8-32, Pressed Steel
Base, 20 ga. Cold Rolled Sheet Steel

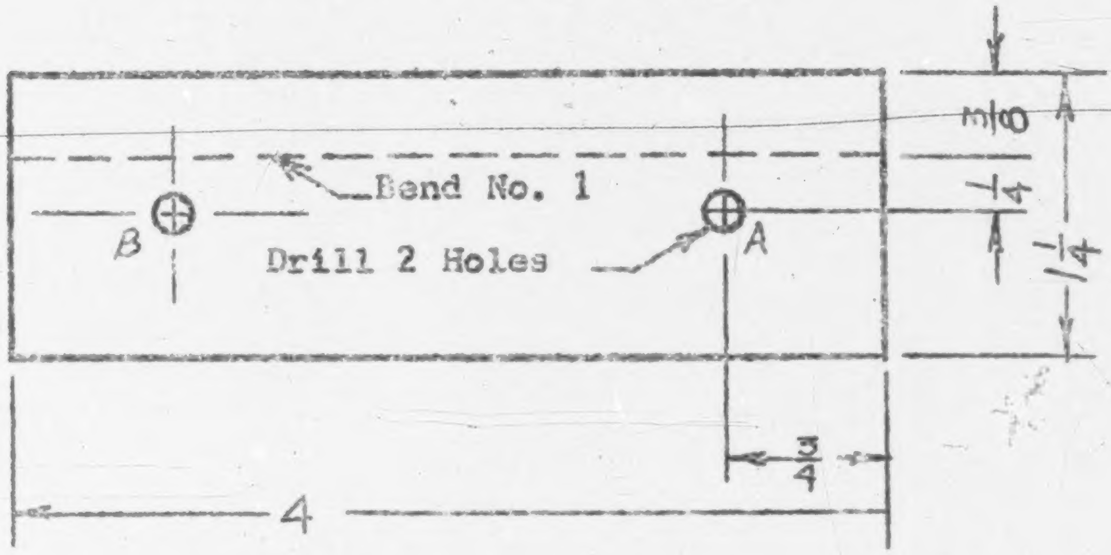
ASSEMBLY DRAWING: The drawing shows how the parts are put together. It also gives specifications for the materials used.


Bend No. 3
3/4
1 1/4
8 1/2
Bend No. 1
Bend No. 2
A
B
3/16 Drill 2 Holes
3/4
1/2
1
1/2
4

Note: Smooth all edges and corners with a file.

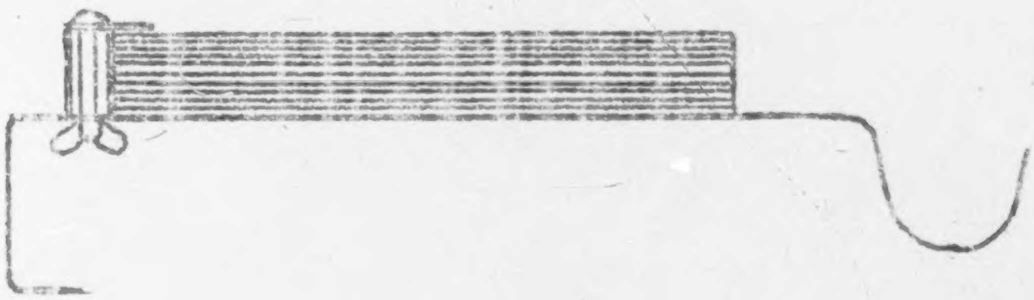
FULL SCALE LAYOUT OF NOTE PAD HOLDER BASE

APPENDIX II (Continued)


3/8
Bend No. 1
B
A
Drill 2 Holes
1/4
1 1/4
3/4
4

Note: File all edges and corners smooth.

FULL SCALE LAYOUT OF NOTE PAD HOLDER CLAMP



PROFILE VIEW OF NOTE PAD HOLDER

APPENDIX IV

MANUFACTURING INCORPORATED
BILL OF MATERIALS

Product: Note Pad Holder Date Needed: 8/7/67

Stock Number: NPH-67

Direct Materials

Part	Material	Material Stock No.	Quantity per Unit
Clamp	20 ga. CRSS, 1½" x 4"	S1010	1 pc.
Base	20 ga. CRSS, 4" x 8½"	S1010	1 pc.
Fastener	#8-32, 7/8", Truss-headed steel machine screw, zinc chromate coated.	83278TZ	2 ea.
Fastener	#8-32 Pressed steel wing nut	832PSW	2 ea.
Pad	½" x 4" x 5", 16 lb. paper	P54516	1 ea.
Paint	Red scarlet, spraycan, for clamp	PR-1	.04 can
Paint	Gray, spraycan, for base	G-1	.1 can
Indirect Materials			
Rags	Lint-free, 8" x 10"	TR-1	.006 lb.
Cleaner	Oleum (non-flammable)	764	.02 qt.
Steel wool, 3/0		SW10	.04 pad

BILL OF MATERIALS: The bill of materials is prepared by the Design Department. The bill lists the amount of materials needed to make one note pad holder. Direct materials are materials which become part of the finished note pad holder. For example, a clamp becomes part of one holder. A small amount of paint becomes part of one holder. Indirect materials are used to make the note pad holder but they do not become part of the finished holder. Rags and cleaner are used to clean the metal before painting. The rags and cleaner do not become part of the finished product. The stock number identifies a particular kind of material. CRSS means cold rolled sheet steel.

Appendix V

JOB DESCRIPTION
PART A (Base)

JOB	DESCRIPTION	EQUIPMENT
1. Layout ink Application	1.(a) Apply layout ink to stock.	1. Shoe polish applicator.
2. Layout holes	2.(a) Position part in holder (b) Position template #1 (c) Mark holes	2. Material holder Template #1 Scriber
3. Layout #1 bend	3.(a) Position part in holder (b) Position template #2 (c) Scribe line	3. Material holder Template #2 Scriber
4. Layout #2 bend	4.(a) Position part in holder (b) Position template #3 (c) Scribe line	4. Material holder Template #3 Scriber
5. Layout #3 bend	5.(a) Position part in holder (b) Position template #4 (c) Scribe line	5. Material holder Template #4 Scriber
6. Layout end cutoff	6.(a) Position part in holder (b) Position template #5 (c) Scribe lines	6. Material holder Template #5 Scriber
7. Inspection	7.(a) Check hole and cutoff layout with template #6 (b) Spot check bend lines with steel rule	7. Material holder Template #6 Steel rule
8. Centerpunch	8.(a) Centerpunch hole A (b) Turn stock over (c) Centerpunch hole B (d) Place material in stock box	8. Hammer Centerpunch Stock box
9. Drill	9.(a) Position material in Fixture #1 (b) Drill hole A (c) Re-position material in Fixture (d) Drill hole B	9. Drill Press 3/16" Bit Fixture #1

Appendix V Continued

10. Shear end cutoff	10.(a)Cut off corners as marked	10. Squaring Shear
11. Remove burrs (hole)	11.(a)Place part in vice (b)Remove sharp burrs	11. Hand drill Countersink Vise
12. Remove burrs (edges)	12.(a)File off burrs (b)Round corners	12. File Vise
13. Bend #1	13.(a)Bend #1 along scribed line to 90°	13. Box & Pan Brake
14. Bend #2	14.(a)Bend #2 to 45° along scribed line	14. Bar Folder
15. Bend #3	15.(a)Bend #3 to 90° along scribed line	15. Box & Pan Brake
16. Roll end	16.(a)Place slotted rod in vise (b)Place end of stock in vise (c)Roll end around slotted rod	16. Vise Slotted rod
17. Inspection	17.(a)Visually inspect finished body next to model	17. Body model
18. Clean	18.(a)Wipe surfaces clean	18. Rag Solvent
19. Spray paint	19.(a)Spray paint part	19. Spray can Paint hook
20. Inspection	20.(a)Visually inspect part	20. ---
21. Assembly	21.(a)Assemble part A and part B with other components	21. Screwdriver Wrench

Appendix VI

JOB DESCRIPTION
PART B (Clamp)

JOB	DESCRIPTION	EQUIPMENT
1. Layout ink Application	1.(a)Apply layout ink to stock	1. Shoe polish applicator
2. Layout holes	2.(a)Position part in holder (b)Position template #7 (c)Mark holes	2. Material holder Template #7 Scriber
3. Layout #1 bend	3.(a)Position part in holder (b)Position template #8 (c)Scribe line	3. Material holder Template #8 Scriber
4. Centerpunch	4.(a)Centerpunch holes	4. Hammer Centerpunch
5. Inspection	5.(a)Check hole and bend layout with template #9 (b)Place material in stock box	5. Material holder Template #9 Stock box
6. Punch holes	6.(a)Punch holes where centerpunched	6. Hand Punch
7. Inspection	7.(a)Check holes with template #10	7. Material holder Template #10
8. Remove burrs (edges)	8.(a)File off burrs (b)Round corners	8. File Vise
9. Bend #1	9.(a)Bend #1 to 90° along scribed line	9. Bar Folder
10. Inspection	10.(a)Visually inspect clamp	10. ----
11. Clean	11.(a)Wipe surfaces clean	11. Rag Solvent
12. Spray paint	12.(a)Spray paint part	12. Spray can Paint hook
13. Inspection	13.(a)Visually inspect part	13. ----
14. Assembly	14.(a)Assemble part B and part A with other components	14. Screwdriver Wrench

APPENDIX VI PART C

GENERAL MATERIALS HANDLING JOB SPECIFICATIONS

1. Receiving Clerk

    A. Must be able to read purchase orders.
    B. Must be able to check materials specifications.
    C. Must be able to work with the inventory and materials storage system.

2. Production Controller

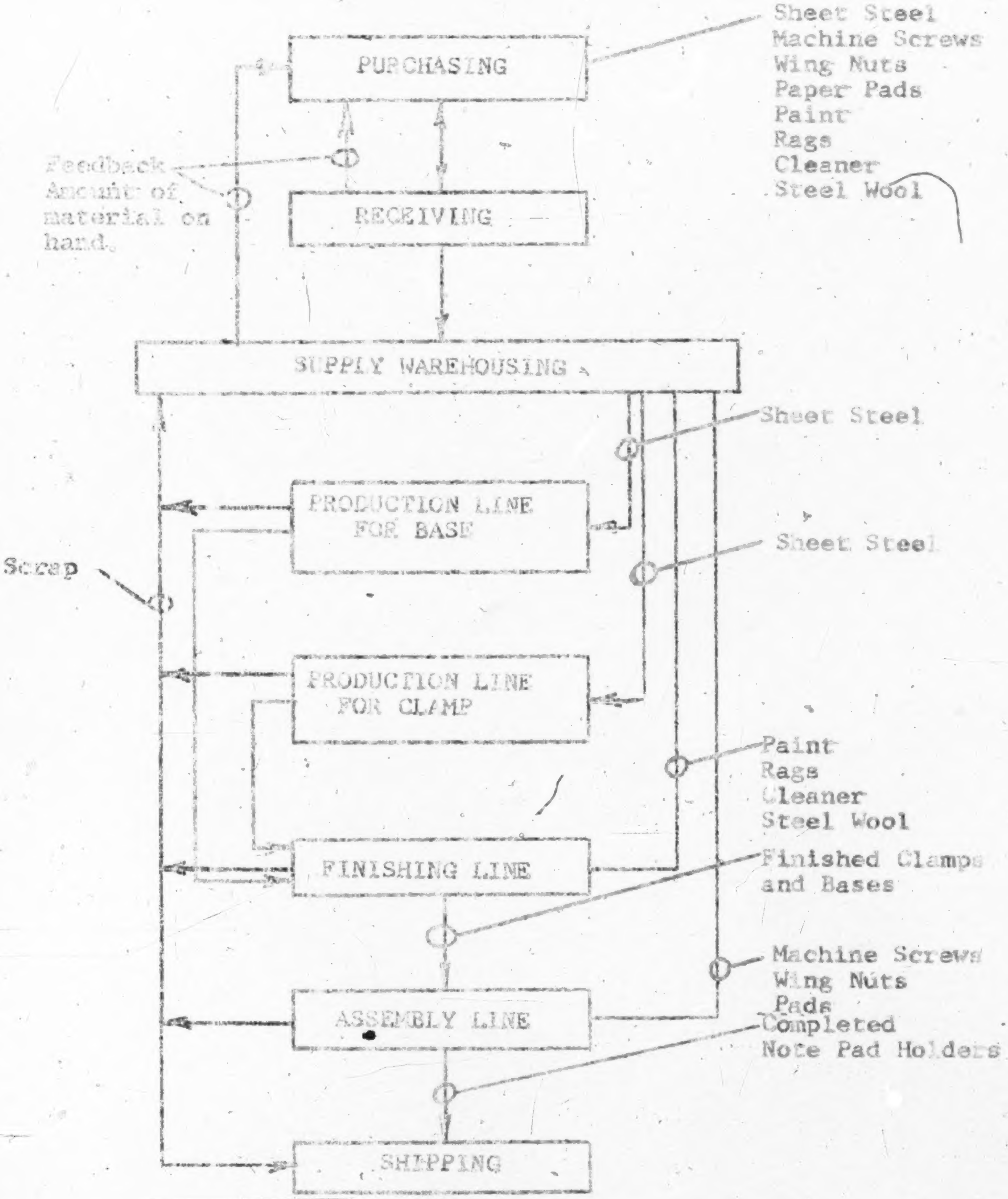
    A. Must understand the flow of materials.
    B. Must be able to teach others to do materials-handling jobs.
    C. Must be able to count parts.
    D. Must be able to work with materials handlers.

3. General Materials Handler

    A. Must be able to lift and carry the heaviest load carried in the note pad holder production line.
    B. Must be able to read move orders.
    C. Must be able to count parts.
    D. Must be safety conscious.

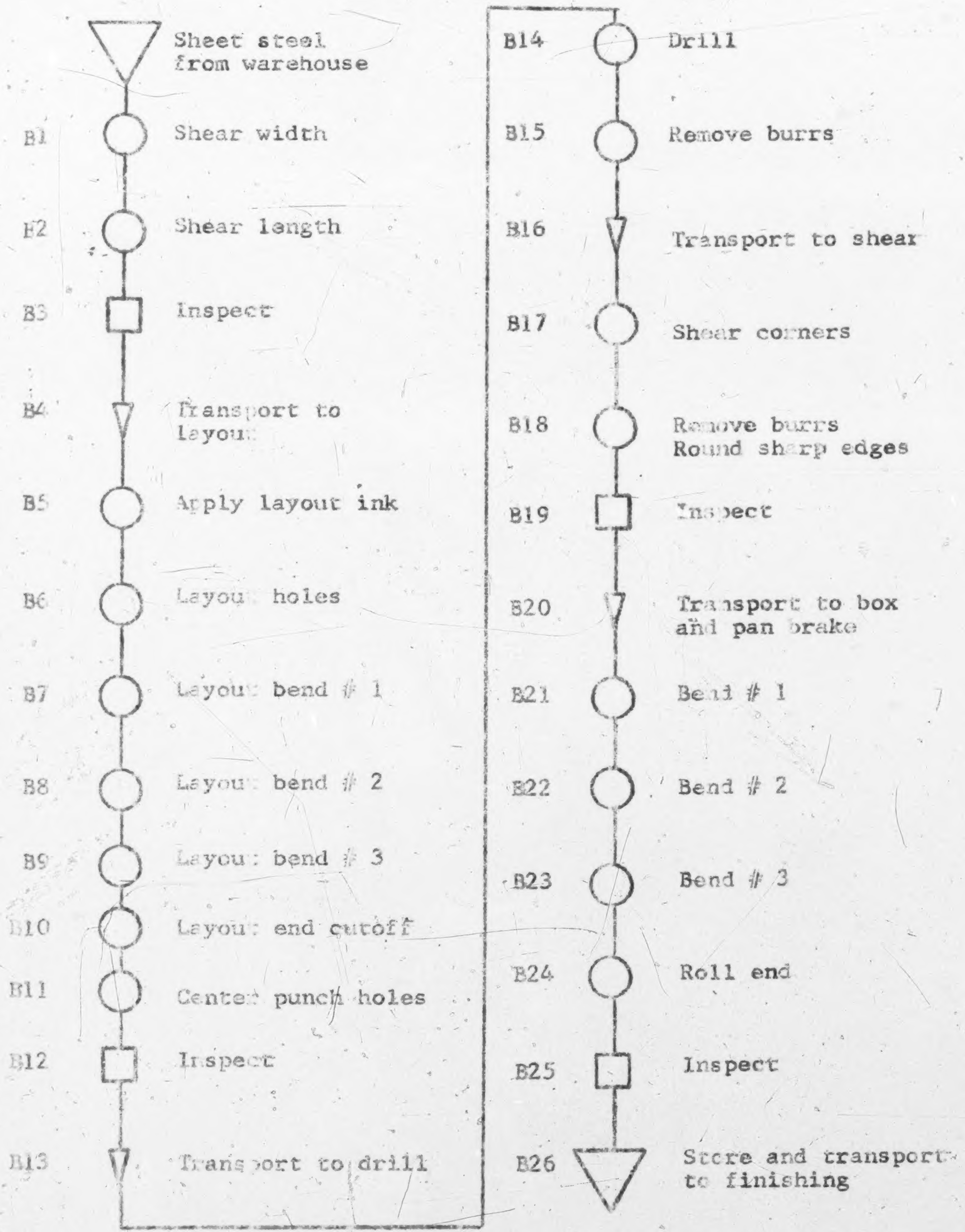
APPENDIX VIII

FLOW OF MATERIALS FOR NOTE PAD AND PENCIL HOLDER


PURCHASING
Sheet Steel
Machine Screws
Wing Nuts
Paper Pads
Paint
Rags
Cleaner
Steel Wool
Feedback
Amount of
material on
hand.
RECEIVING
SUPPLY WAREHOUSING
Sheet Steel
PRODUCTION LINE
FOR BASE
Sheet Steel
Scrap
PRODUCTION LINE
FOR CLAMP
Paint
Rags
Cleaner
Steel Wool
FINISHING LINE
Finished Clamps
and Bases
Machine Screws
Wing Nuts
Pads
ASSEMBLY LINE
Completed
Note Pad Holders
SHIPPING

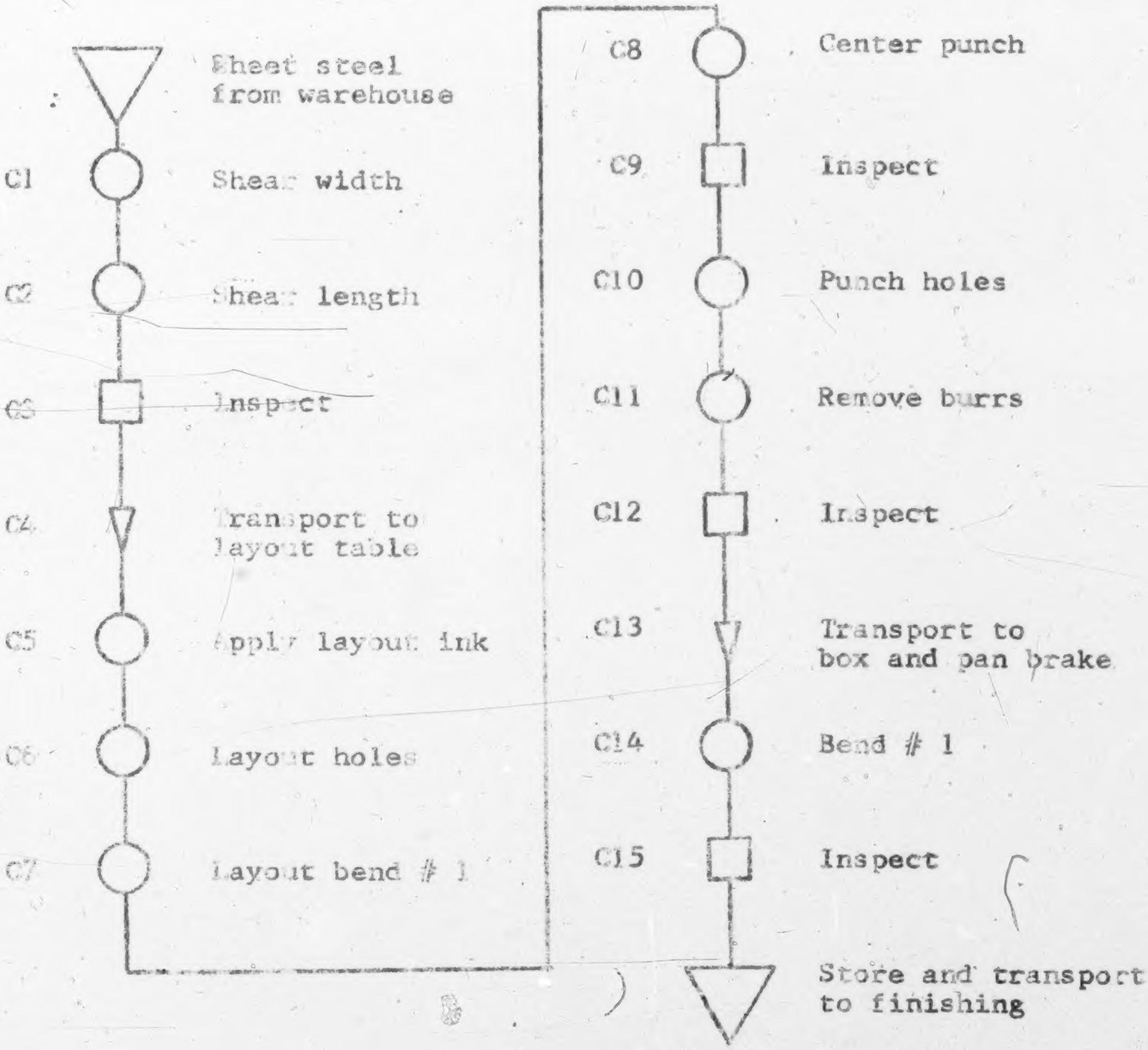
APPENDIX VIII (Continued)

FLOW CHART FOR PRODUCTION OF BASE


Sheet steel from warehouse
B1 Shear width
B2 Shear length
B3 Inspect
B4 Transport to layout
B5 Apply layout ink
B6 Layout holes
B7 Layout bend # 1
B8 Layout bend # 2
B9 Layout bend # 3
B10 Layout end cutoff
B11 Center punch holes
B12 Inspect
B13 Transport to drill
B14 Drill
B15 Remove burrs
B16 Transport to shear
B17 Shear corners
B18 Remove burrs Round sharp edges
B19 Inspect
B20 Transport to box and pan brake
B21 Bend # 1
B22 Bend # 2
B23 Bend # 3
B24 Roll end
B25 Inspect
B26 Store and transport to finishing

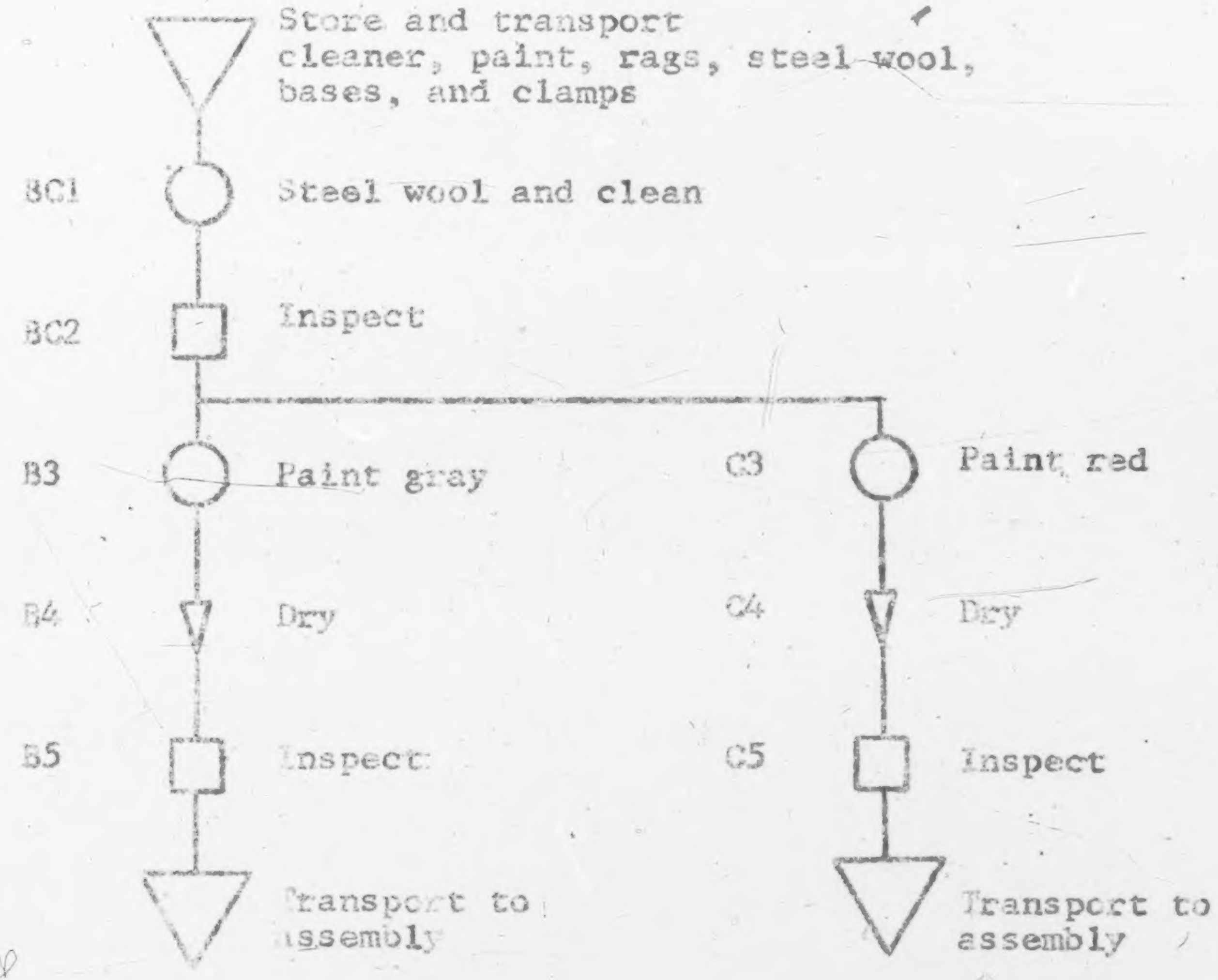
APPENDIX VIII (Continued)

FLOW CHART FOR PRODUCTION OF CLAMP

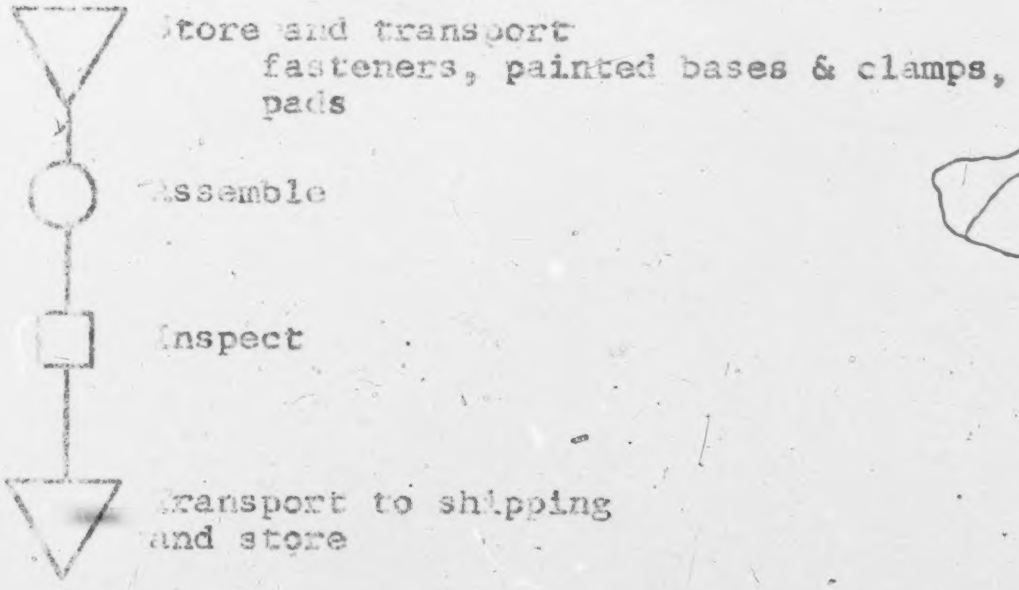

Sheet steel from warehouse
C1 Shear width
C2 Shear length
C3 Inspect
C4 Transport to layout table
C5 Apply layout ink
C6 Layout holes
C7 Layout bend # 1
C8 Center punch
C9 Inspect
C10 Punch holes
C11 Remove burrs
C12 Inspect
C13 Transport to box and pan brake
C14 Bend # 1
C15 Inspect
Store and transport to finishing

APPENDIX VIII (Continued)

FLOW CHART FOR FINISHING LINES


Store and transport cleaner, paint, rags, steel wool, bases, and clamps
BC1
Steel wool and clean
BC2
Inspect
B3
Paint gray
C3
Paint red
B4
Dry
C4
Dry
B5
Inspect
C5
Inspect
Transport to assembly
Transport to assembly

FLOW CHART FOR ASSEMBLY LINE


Store and transport fasteners, painted bases & clamps, pads
Assemble
Inspect
Transport to shipping and store

Appendix IX
MACHINES, TOOLS, EQUIPMENT

PART A (Body)

1. Scriber (5)
2. Steel Rule
3. Hammer
4. Centerpunch
5. Drill Press
6. 3/16" Drill Bit
7. Squaring Shear
8. Hand Drill
9. Countersink
10. Vise (2)
11. Box and Pan Brake
12. Bar Folder
13. Screwdriver
14. Wrench
15. File (2)

1. Scriber (2)
2. Hammer
3. Centerpunch
4. Hand Punch
5. File
6. Vise
7. Bar Folder
8. Screwdriver
9. Wrench

Appendix X

SPECIAL EQUIPMENT

PART A (Body)

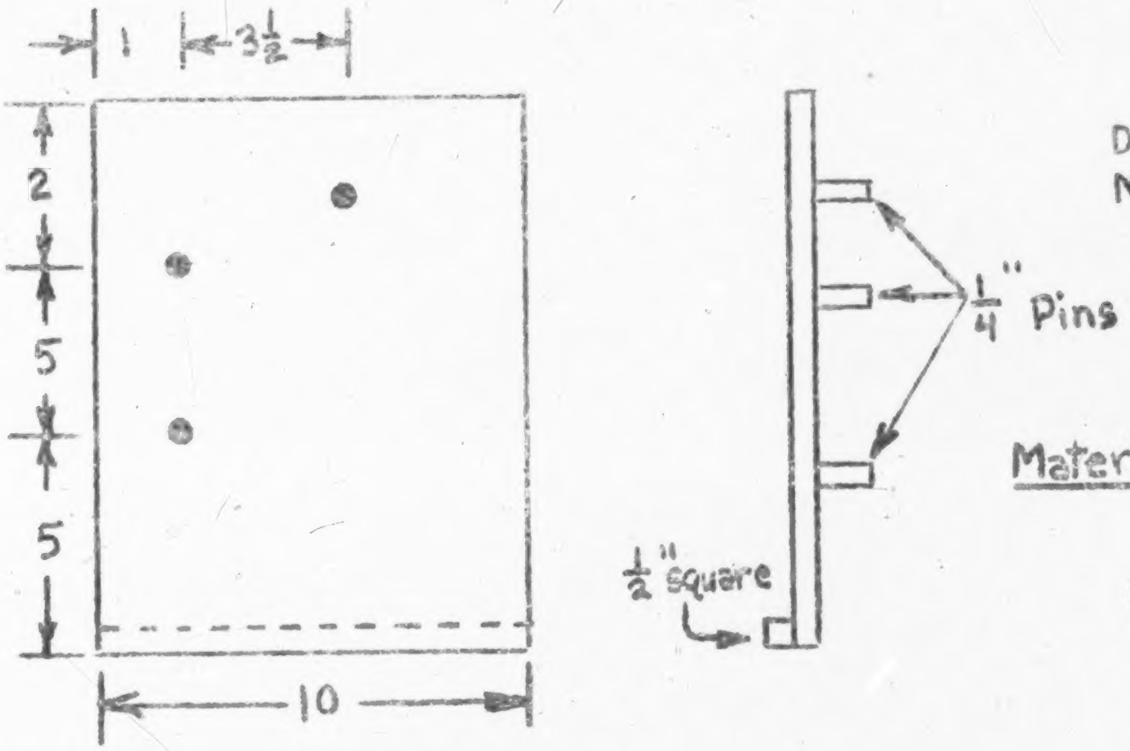
1. Shoe Polish Applicator (2)
   - (a) For layout ink
2. Templates (7)
   - (a) Holes
   - (b) Bend #1
   - (c) Bend #2
   - (d) Bend #3
   - (e) End Cut-off
   - (f) Inspection (2)
3. Fixtures (7)
   - (a) Material holder (6)
     - (1) For hole, bends and cutoff layout work.
     - (2) For inspection
   - (b) Drill Press #1
4. Stock Box (2)
5. 5/8" Slotted Rod
6. Body Model
7. Paint Hook (20)

PART B (Clamp)

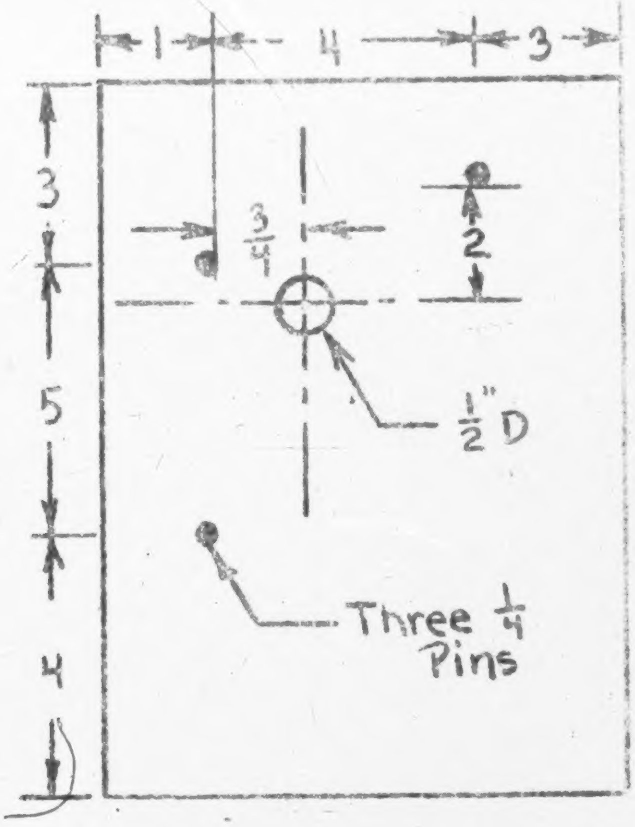
1. Shoe Polish Applicator
   - (a) For layout ink
2. Template (4)
   - (a) Holes
   - (b) Bend #1
   - (c) Inspection (2)
3. Material Holder (4)
   - (a) For hole, bend layout work
   - (b) For inspection
4. Stock Box
5. Paint Hook (20)

Appendix XI

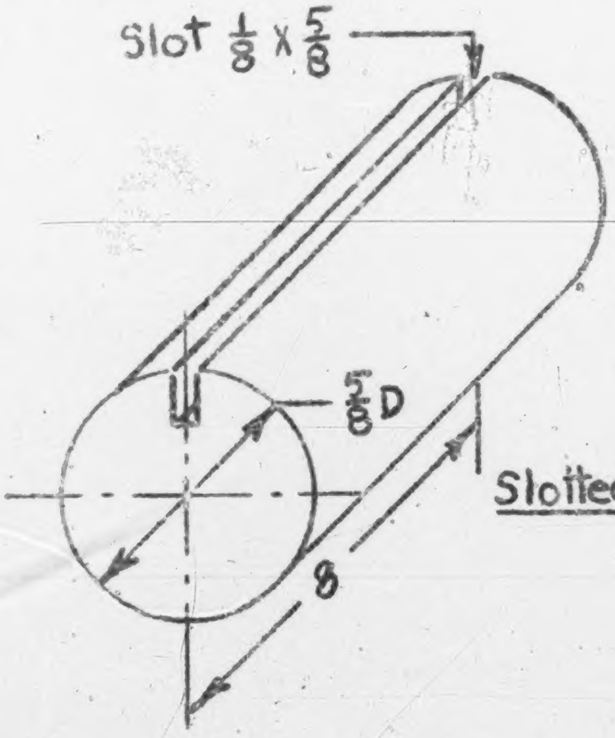
DRAWINGS ARE NOT TO SCALE


1
3 1/2
2
5
5
10
1/4" Pins
1/2" square

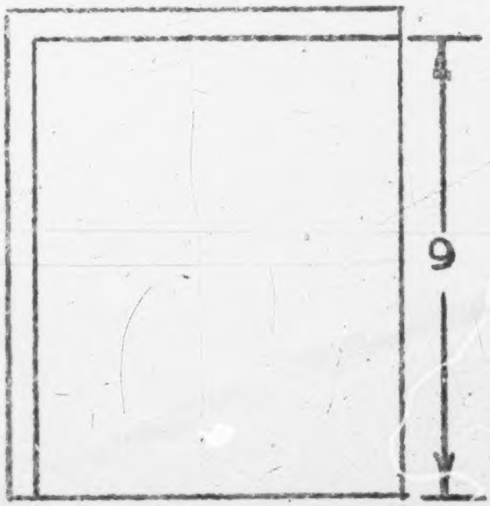
Material Holder


1
4
3
3
3/4
2
5
1/2" D
Three 1/4 Pins
4

Drill Press Fixture #1


Slot 1/8 x 5/8
5/8 D
8

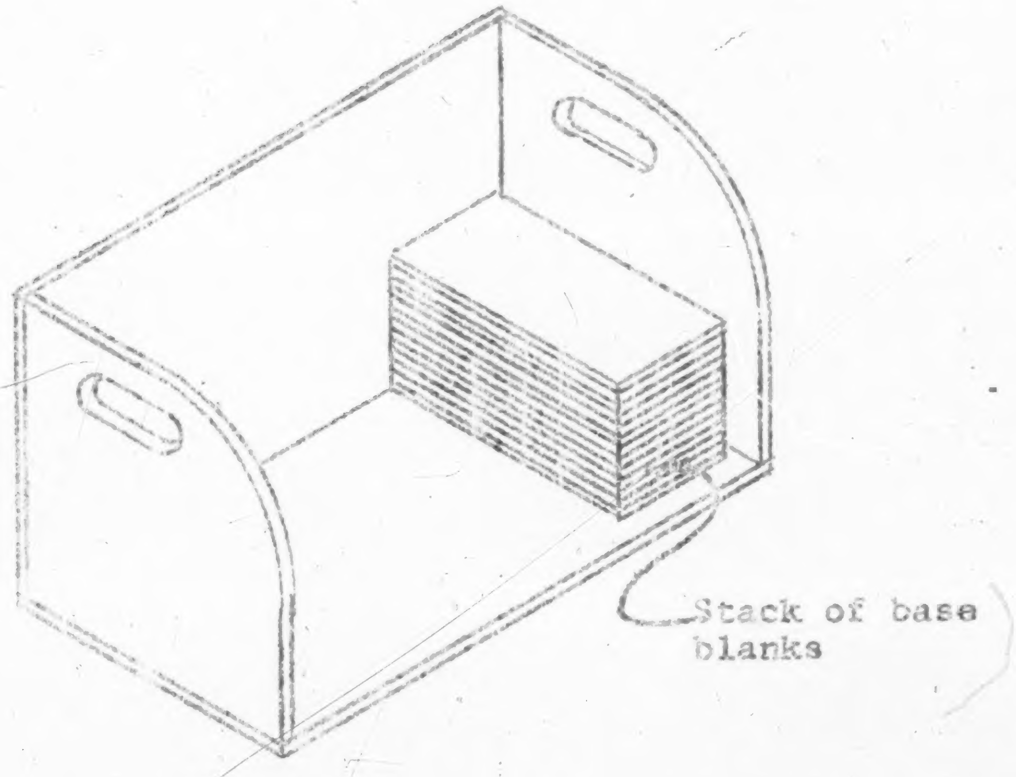
Slotted Rod



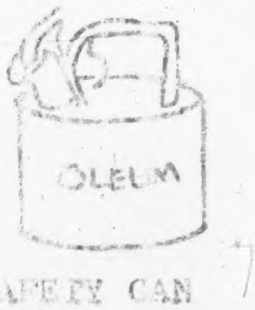
Stock Box

APPENDIX XI

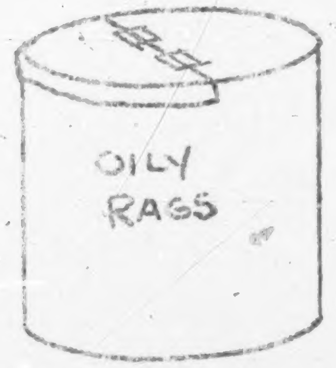
MATERIALS HANDLING EQUIPMENT


Stack of base blanks

TOTE TRAY FOR CARRYING PARTS

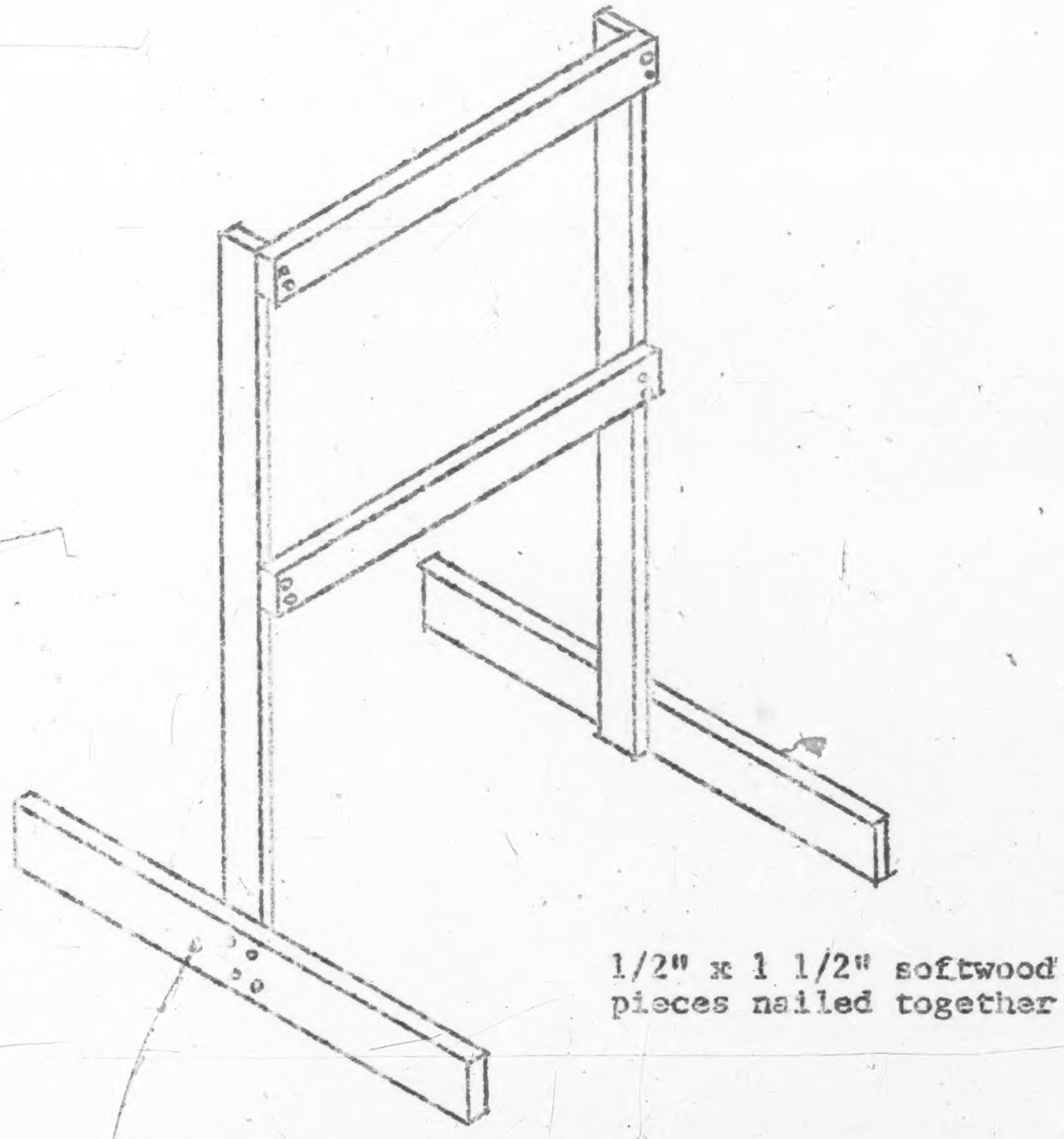


SAFETY CAN
FOR CLEANER



CLOSED METAL CONTAINER
FOR FLAMMABLE RAGS

APPENDIX XI (Continued)

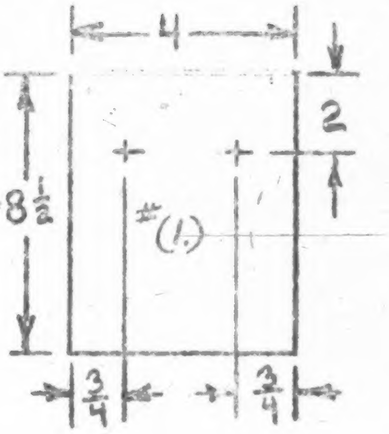

1/2" x 1 1/2" softwood pieces nailed together

SIMPLE DRYING RACK FOR STORING PAINTED PARTS

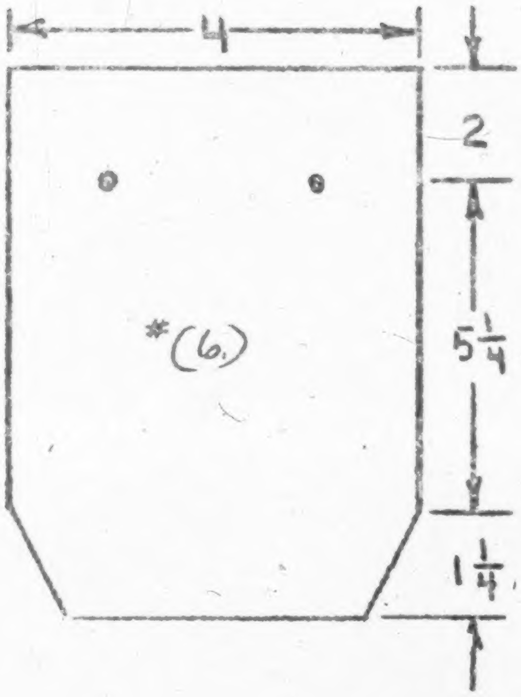
Paint hooks made from coat hangers or heavy wire.
Hook designed to prevent any part from touching a wet painted surface.

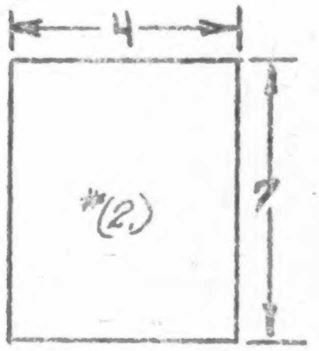
WIRE HOOK FOR HANGING PARTS ON RACK

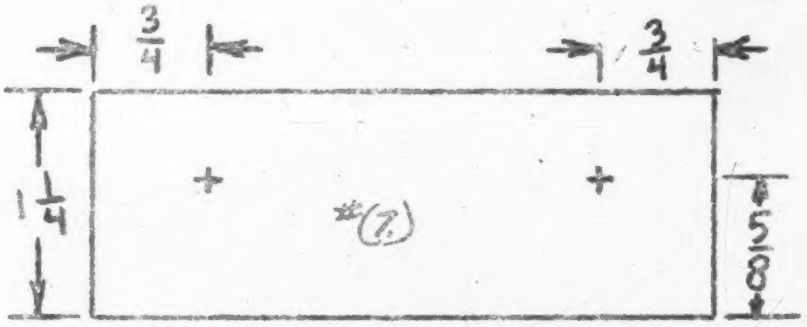
Appendix XIII

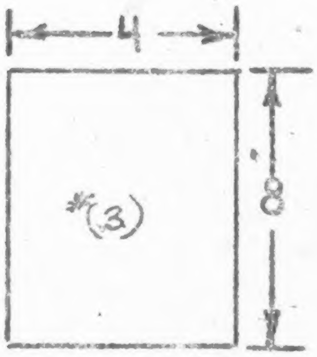

4
2
8 1/2
#(1.)
3/4
3/4

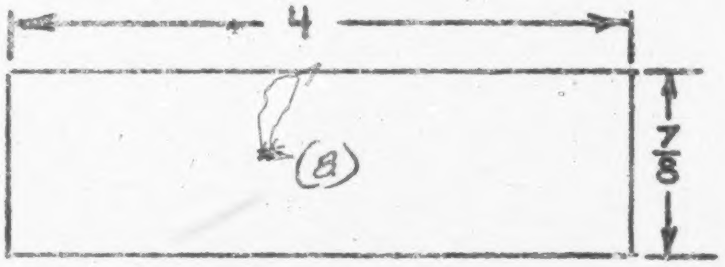
Templates are not drawn to scale

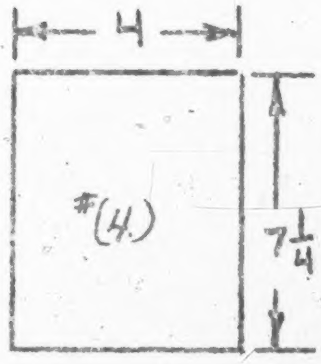


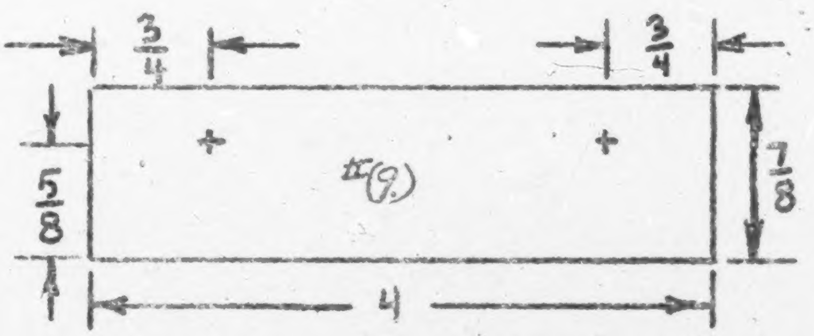


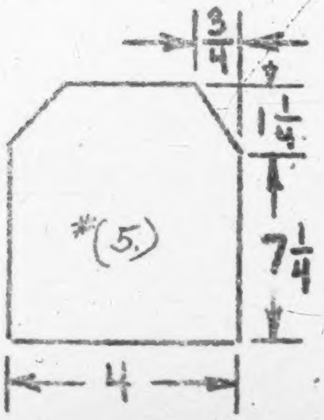

3/4
3/4
1 1/4
#(7.)
5/8

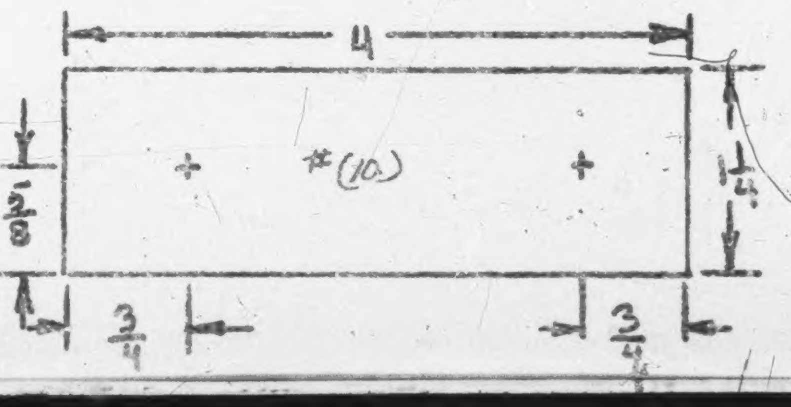







3/4
3/4
5/8
#(9.)
7/8
4


3/4
1 1/4
#(5.)
7 1/4
4


4
5/8
#(10.)
1 1/4
3/4
3/4

APPENDIX XIV

MANUFACTURING INCORPORATED
PURCHASE ORDER

To: Industrial Materials Supply Co.
1768 Warehouse Road
Primary Processing, U. S. A.

P. O. No. 1001
Today's Date 7/2/67
Date Needed 7/8/67

Quantity	Material Specifications	Stock Number	Cost
1 sheet	20 ga. CRSS, 24" x 96"	S1010	6.00
1 box (100)	#8-32, 7/8", Truss-headed steel machine screws, zinc chromate coated	83278TZ	.61
1 box (100)	#8-32 Pressed steel wing nuts	832PSW	2.30
50 ea.	Writing pads, ½" x 4" x 5", 16 lb. paper	P54516	1.50
1 can	Spray paint, scarlet red	PR-1	.88
5 cans	Spray paint, gray	G-1	4.40
1 qt.	Oleum (non-flammable cleaner)	764	1.80
1 pkg.	Steel wool, 1/0	SW10	.10
			$17.59

Ship to: Manufacturing Incorporated
2047 Neil Avenue
Columbus, Ohio 43201

PURCHASE ORDER: Sometimes purchase orders must be sent to more than one vendor.

MANUFACTURING INCORPORATED

APPLICATION FOR EMPLOYMENT

Interviewer	
Date	Class
	Job

NAME ____
Last First Middle

ADDRESS ____
No. Street City State

PHONE ________________ SOCIAL SECURITY NO. ______________

HEIGHT ____________ WEIGHT __________ BIRTHDATE __________

MALE _____ FEMALE ______

JOB FOR WHICH YOU ARE APPLYING ______________________

WHY DO YOU WANT TO WORK FOR THIS COMPANY? ____________

____

____

____

EXPERIENCE ____

____

PRESENT OR LAST EMPLOYER ____________________________________

____
Address

WHICH TOOLS HAVE YOU USED?

HAND TOOLS - Saws ____ Wrenches ____

Files ____ Hammers ____

POWER TOOLS - Drills ____ Sanders ____

Saws ____

MANUFACTURING, INC.

Weekly Time Card

Name____

Dept.____

Week-Ending__________________________________

Day-Date	Total Hours	Over Time	Hourly Rate	Earning per Day
Sun.				
Mon.				
Tues.				
Wed.				
Thurs.				
Fri.				
Sat.				
Total				

Signature______________________________

Appendix XVI

ED 065731

industrial arts

ndea
institute
for
advanced
study

manufacturing

~~VT 015 797~~
VT 016 263

the ohio state university
1967

FILMED FROM BEST AVAILABLE COPY

Instructional Materials

in

MANUFACTURING

for

Junior High School Industrial Arts

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION
THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL OFFICE OF EDUCATION POSITION OR POLICY.

Part IV of IV

Product Synthesis C

Summer 1967

NDEA Institute for Advanced Study
in Industrial Arts
The Ohio State University
Columbus, Ohio
43210

Part IV of IV

Product Synthesis C

Other Instructional Materials

In This Series

Generalized Manufacturing Technology
Regardless of Product Part I

Product Synthesis A Part II

Product Synthesis B Part III

PREFACE

This synthesis unit in manufacturing was developed by eight participants of the 1967 Summer NDEA Institute for Advanced Study in Industrial Arts held at The Ohio State University. Two other product synthesis units similar to this one, together with the collection of units entitled "Generalized Manufacturing Technology Regardless of Product", complete the series of instructional materials developed during the eight week session.

Each group of eight men selected a product that could be manufactured in a junior high school industrial arts laboratory. They were encouraged to develop instructional materials that extend the structure of manufacturing technology as it had relevance for the product chosen. The materials have been written at approximately the 7th grade level of readability, and will be useful to teachers and pupils alike.

The general approach used by each group was common since the planned activities culminate in the operation of a managed production system in manufacturing. The means used in exemplifying this system, however, vary greatly. It is hoped that these units will spark the imagination of industrial arts teachers so that they will attempt new and better ways of interpreting the vast system of manufacturing to junior high school pupils.

Arthur W. Earl, Professor
Instructional Materials
Development Workshop

INSTITUTE STAFF

Dr. Willis E. Ray, Professor of Education
The Ohio State University
Director of the Institute

Dr. Arthur W. Earl, Professor and Chairman
Department of Industrial Education and Technology
Montclair State College, Montclair, New Jersey
Instructional Materials Development

Dr. Donald R. Kibbey, Assistant Professor of
Industrial Engineering
The Ohio State University
Advanced Manufacturing Management, Personnel and
Production Technology

Dr. Donald G. Lux, Professor of Education
The Ohio State University
Advanced Industrial Arts Curriculum

Arthur J. Rosser, Doctoral student in
Industrial Arts
The Ohio State University
Administrative Assistant

John Butala, Jr., Doctoral student in
Industrial Arts
The Ohio State University
Instructional Assistant

Phillip A. Fazzini, Doctoral student in
Industrial Arts
The Ohio State University
Instructional Assistant

Miss Grace M. Twine--Secretary

CONTRIBUTORS

Product Synthesis C

E. Keith Blankenbaker
Brittany Junior High School
University City, Missouri 63139

Vern M. Bonar
Old Mission Junior High School
Shawnee-Mission, Kansas 66205

Hammond J. Briscoe, Jr.
Harlem Park Junior High School
Baltimore, Maryland 21217

Forrest L. Cullings
Northview Junior High School
Indianapolis, Indiana 46240

Joseph L. Pucel
Hosterman Junior High School
Minneapolis, Minnesota 55428

Harrison Williams
Jack Benny Junior High School
Waukegan, Illinois 60085

Thomas E. Williams
Springfield Junior High School
Battle Creek, Michigan 49015

Eugene Woolery
Orville Wright School
Gorman School
Webster School
Dayton, Ohio 45405

TABLE OF CONTENTS

UNIT	PAGE
Overview	1.1
Design	2.1
Plant Layout	3.1
Jigs and Fixtures	4.1
Personnel Department	5.1
Production	6.1
Safety	7.1
Cost Control	8.1
Final Examination	9.1
Notes to the Teacher	10.1

OVERVIEW :

PART I

OBJECTIVIES

The student should be able:

1. Understand the structure of Determination Grill Rake Company.
2. Gain an understanding of the manufacturing problems involved in Determination Grill Rake Company.
3. Understand how teamwork, interchangeable parts and carefully prepared procedures can result in the production of a satisfactory product.

INTRODUCTION

One of the best ways to understand how manufacturing industries work is to become involved in the establishment and operation of a manufacturing company. In the next few weeks we will organize and operate a small manufacturing company in this class. The purpose of this firm will be to produce grill rakes. (Fig. A).

From this study it will become evident that organization is the key to the mass production of any product.

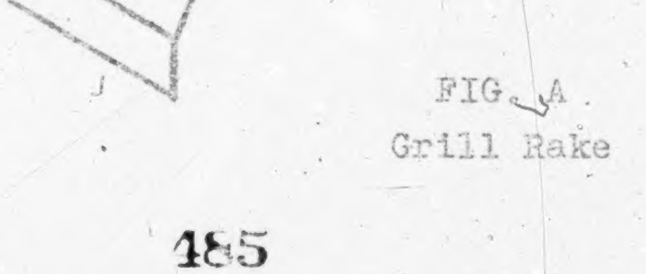


FIG. A
Grill Rake

For the purpose of instruction, certain limits will need to be placed on the firm in order that we can work with it as an instructional tool. The purpose of this introduction will be to introduce you to an established firm (Determination Grill Rake Company) to show you how it operates and how you can change its operation.

ORGANIZATION

The organization chart shows the relationship of each of the members of Determination Grill Rake Company (D. G. R. Co.). (Fig. B). You will need to refer to it often as you study the duties of each of the people represented in the company.

Board of Directors

The Board of Directors of the D. G. R. Co. will be made up of all class members. Each member will have one vote in all decisions. The board will elect all second level management (Vice President Engineering, Vice President Personnel, Vice President Production, Control Supervisor, Vice President in Charge of Quality, Vice President Safety). The board will approve design modifications in the grill rake which are recommended by the Engineering Department. As a board member you will be expected to ask questions as to procedure, cost, materials, etc. Board members will have an opportunity to learn how the entire company functions.

DETERMINATION GRILL RAKE CO.

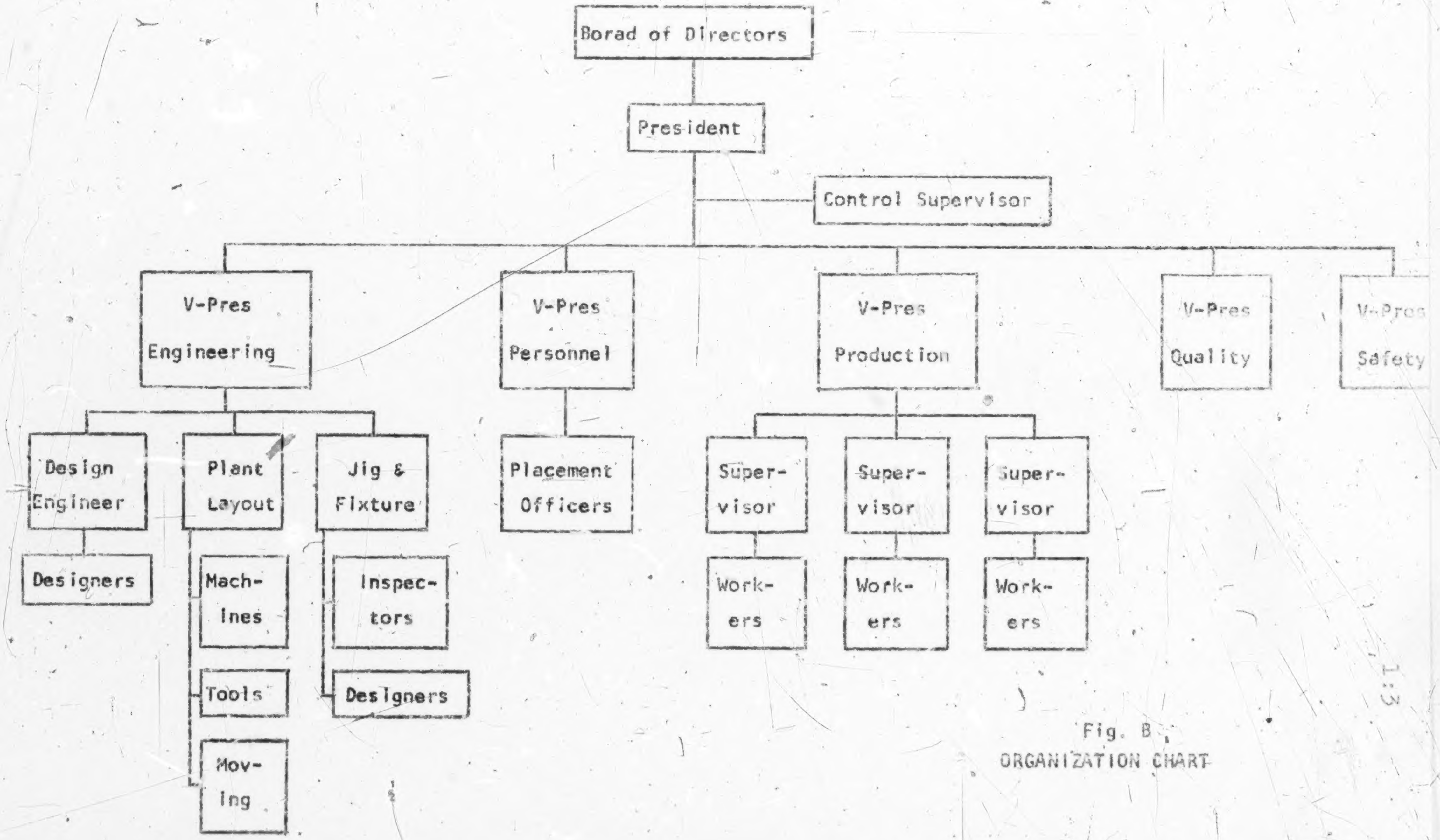

Borad of Directors
President
Control Supervisor
V-Pres Engineering
V-Pres Personnel
V-Pres Production
V-Pres Quality
V-Pres Safety
Design Engineer
Designers
Plant Layout
Mach-ines
Tools
Mov-ing
Jig & Fixture
Inspec-tors
Designers
Placement Officers
Super-visor
Work-ers
Super-visor
Work-ers
Super-visor
Work-ers

Fig. B
ORGANIZATION CHART

President

The instructor will act as President of this firm. This seems to be necessary since you lack experience with the organization and operation of D. G. R. Co. In this capacity the instructor will serve as a source of information and provide direction for this activity.

Control Supervisor

The Control Supervisor of D. G. R. Co. will maintain records of materials used and time spent in each of the departments. This information will be recorded on prepared forms and summaries of these costs will be presented at board meetings. He will serve as a check to determine the cost of products.

To function properly the Control Supervisor should display the following characteristics:

1. Reliability--does work accurately and completes work on time.
2. Skill in working with numbers.
3. Neat in his work.
4. Ability to present report to Board of Directors.
5. Ability to get along with people.

Vice President of Engineering

The Vice President of Engineering of D. G. R. Co. will direct the activities of the Engineering Department. This will include:

1. Changes in the grill rake design.
2. Development of plant layout for production of the grill rake.
3. Design of a jig or fixture for making the handle according to the design change.

He will make a report of progress to each board meeting and a report of cost to the Control Supervisor.

To function effectively in this position a person should have the following characteristics:

1. Leadership--ability to organize and direct the activities of other people.
2. Ability to think through complex problems.
3. Ability to get along with people.
4. Ability and desire to work with materials.
5. Ability to present reports to board meetings.

Vice President of Personnel

The Vice President of Personnel in D. G. R. Co. will direct his department as it:

1. Studies job specifications (descriptions of what each worker must do).
2. Studies application procedure and the policy for placing workers.
3. Makes changes or additions to the job specifications as a result of design change.

The Vice President of Personnel will report to each board meeting and to the Cost Control Department.

The characteristics of a good Vice President of Personnel are:

1. Leadership--ability to organize and direct the activities of other people.

2. Ability and desire to work with people.
3. Ability to write clearly.
4. Ability to present report at board meeting.

Vice President of Production

The Vice President of Production of the D. G. R. Co. will direct the activities of the Production Department. This department will be responsible for establishing procedure for handling raw materials and for training of machine operators. Nearly everyone will be working under the direction of the Vice President of Production when we actually begin to turn out grill rakes. He must report to each board meeting.

Characteristics of an effective Vice President of Production are:

1. Ability to organize and direct people.
2. Likes to work with machines and materials.
3. Ability to find solutions to complex production problems.
4. Ability to present report at board meeting.

Vice President of Quality

The Vice President of Quality will:

1. Study quality control procedures.
2. Determine how gauges are used to measure accuracy of grill rake parts.
3. Report any production that does not meet standards to Vice President of Production for correction.
4. Design gauges to test the accuracy of any new shapes or parts created by design change.

5. Report to all board meetings.

This position will not be filled until lecture-demonstration on shop processes.

Characteristics of a good Vice President of Quality are:

1. Ability to observe details.
2. Reliability.
3. Ability to present report to board meetings.
4. Ability to get along with other people.

Vice President of Safety

The Vice President of Safety will:

1. Study industrial safety.
2. Check the production line before and during production for safety hazards.
3. Report misconduct to company president.
4. Make report of any injuries.
5. Check first aid supplies.
6. Make a report to each board meeting.

This position will not be filled until the lecture-demonstration on shop processes has been given.

Characteristics of a competent Vice President of Safety are:

1. Interested in safety.
2. Ability to observe details and record observations.
3. Ability to write clearly.
4. Reliability--will do job completely.
5. Ability to report to board meetings.

SUMMARY

It has become obvious that each student will participate in many ways in this activity. All will be members of the board. Some will serve in management positions. Most will serve as workers. This type of involvement in mass production should allow each of you to get a broad overview of how manufacturing industries function. This experience might help you to decide on a career. Certainly it should help you learn to appreciate the place and function of the manufacturing industries in American society.

ACTIVITY

Answer the following questions before the next class meeting.

1. Be prepared to discuss and question the orgnaization and personnel requirements mentioned in the discussion of the organization chart.

2. Decide if you would like to become a part of management and if so, which of the positions discussed will you seek? ____________________

3. Study the enclosed application form. (Fig. C). Do not attempt to complete it. Your instructor will review its use with you in class and direct you in filling it out.

4. What is the purpose of the organization chart?

   ____

   ____

5. As a Board Member, what are your responsibilities?

   ____

FIG. C APPLICATION FORM

For Second Level Management Positions.

Name ____
(Last) (First) (Middle)

Position Applied For ______________________________

Qualifications for This Position

Copy those listed in text.

1. ____
____
2. ____
____
3. ____
____
4. ____
____
5. ____
____

Reasons for Wanting Position

Write a brief statement telling why you would like to serve in this position.

____
____
____
____

Work Experience

Summer Camp

Church

Boy Scouts

Boys' Club

Other

Can You Read Blueprints?

References

After you have completed the blanks above, have three people sign below indicating that they believe you will make a good candidate for this position.

(Teacher, other than Industrial Arts)

Student

Student

The above statements are true to the best of my knowledge.

Signature of Applicant

OVERVIEW

PART II

OBJECTIVES

The student should be able to:

1. Gain an understanding of the problems we face in manufacturing grill rakes.
2. Relate the various elements of manufacturing which we have already studied to this mass production project.

INTRODUCTION

You have learned the responsibilities of each of the members of second level management in Determination Grill Rake Company (D. G. R. Co.). We will now explain procedures of operation for this company.

ELEMENTS OF MANUFACTURING

We have studied the elements of manufacturing (Management, Production, Personnel and the sub-elements of each). (Fig. A). The purpose of this mass production project is to tie these together and show how they work in actual practice. There are several points which should be made as to how the understanding of the relationship can best be achieved. First, each of the elements previously studied may be found to exist as a part of several jobs in D. G. R. Co. For example, the element organizing will be a part of the work of the Vice President of Engineering, the Vice President of Personnel and many other positions in our company.

FIG: A

STRUCTURE OF MANUFACTURING

I. Management

- A. Planning
  - 1. Formulating
  - 2. Researching
  - 3. Designing
  - 4. Engineering
- B. Organizing
- C. Controlling

II. Production

- A. Pre-processing
- B. Processing
  - 1. Primary processing
    - a. Refining
    - b. Converting
    - c. Bulk forming
  - 2. Component processing
    - a. Separating
    - b. Combining
    - c. Forming
  - 3. Assembling
- C. Post Processing

NOTE:

Elements which are printed in red are covered by this mass production project. You should realize that not all the sub-elements under each of these elements will be covered.

Actually everyone will need to organize his work to some degree.

Secondly, some of the sub-elements will not be represented by D. G. R. Co.

Thirdly, we will make use of many job titles in an effort to distinguish between the different jobs in D. G. R. Co. It should be understood that these jobs are made up of activities which were identified as elements of manufacturing. For example, the Vice President of Safety will need to plan, organize and control safety for D. G. R. Co.

DECISION MAKING IN D. G. R. CO.

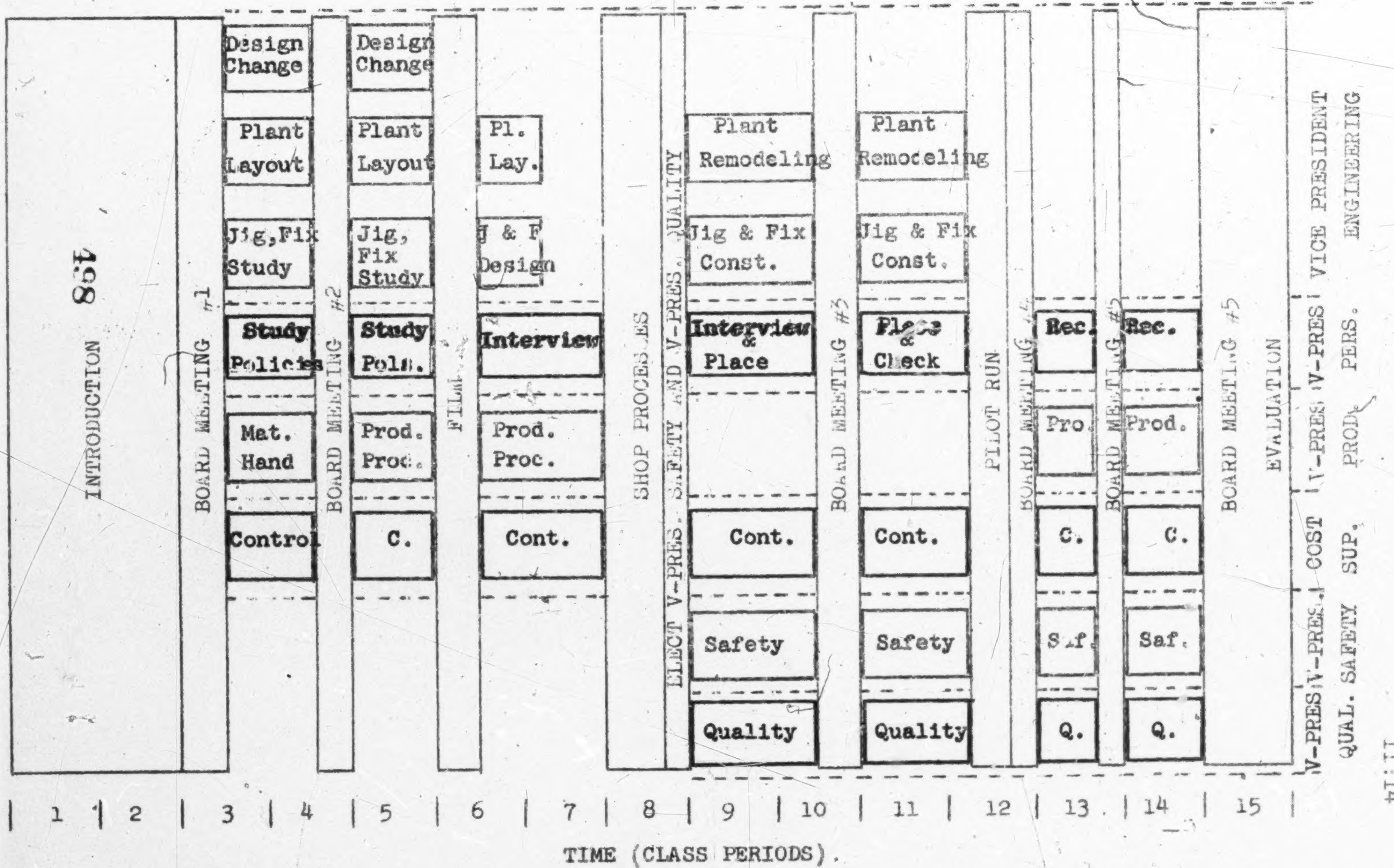
The Board of Directors acts as the policy maker of D. G. R. Co. It is concerned with the "big picture". We will use board meetings for the following reasons:

1. To select second level management.
2. To check the progress of each of the departments.
3. To act as an information exchange device whereby all board members will have an opportunity to exchange ideas.
4. To help board members learn the total function of the company.

The first board meeting will be for the purpose of electing the Vice Presidents of Engineering, Personnel, and Production, and the Control Supervisor. At following board meetings each of the members of second level management will report the progress of his group.

FIG. B

CRITICAL PATH ANALYSIS FOR GRILL RAKE



11:14

HOW ARE WE GOING TO ACHIEVE OUR GOALS?

We will be divided as indicated in the D. G. R. Co. organization chart which you studied in your last assignment. Each person will study all aspects of the manufacturing process. Each will become skilled in those segments of manufacturing to which he is assigned.

TIME SCHEDULE

In order to achieve our goals we need a time schedule. For this purpose a Critical Path Analysis for the Production of Grill Rakes has been provided. (Fig. B). The following explanation will help you understand its meaning.

1. The divisions across the bottom of the page which are numbered 1, 2, 3, etc. represent class periods. For example you are now working on the reading assignment for period 2 of the introduction.
2. The dashed lines (-----) divide the departments, i. e., Engineering, Personnel, etc.
3. The large rectangular blocks labeled Introduction, Board Meeting, Films, etc. indicate times when the class will meet as a group.
4. The small rectangular blocks labeled Design Change, Jig and Fixture, etc. indicate the time allotment for small groups to work on these parts of the project.

This chart is to be used as a guide for study and work. Deadlines must be met. Overtime may be required.

PROCEDURES

After a student has been selected for a particular job he will be given a job specification sheet which will

FIG. C

Sample Job Specification

VICE PRESIDENT ENGINEERING

ACTIVITIES

DAY	PRIMARY RESPONSIBILITIES
3	Select staff of Engineering Department
3	Divide staff into three groups as indicated in the organization chart.
3	Appoint one person to be in charge of each group.
3	See that each group is working according to plans.
4	Check progress of each group and give direction as necessary
4	REPORT TO BOARD MEETING
5	Finalize design change and coordinate other group activities.
6	Finalize plant layout and jig and fixture design.
6	Lay-off staff as they finish their work.
7	Check plant layout and jig or fixture design.
9	Direct plant remodeling
10	REPORT TO BOARD MEETING
11	Complete plant remodeling and jig or fixture construction.
12	REPORT TO BOARD MEETING
15	FINAL REPORT TO BOARD MEETING

READING ASSIGNMENT

Review the following units in the Structure of manufacturing: Management, Planning, Organizing and Controlling

Study the following units in the order they appear: Design, Jigs and Fixtures, Plant Layout, Personnel, Production, Cost Control and Safety.

outline his responsibilities. (Fig. C). The first job specification you receive will contain a reading assignment. The sequence of reading assignments will be determined by your first job. All students will read all assignments but at different times.

As a particular group of individuals finishes its work, they will be laid off by their Vice President. When this happens, report to the Personnel Department immediately.

The class period labeled Shop Processes will be used by the instructor to give an overview of the procedures to be used for the production of grill rakes. You will want to take special note of safety precautions. At the end of this period the Vice President of Engineering and the Vice President of Quality will be selected.

The Pilot Run will be used to determine if:

1. All jobs have been filled.
2. Everyone knows his job.
3. We have any "Bugs".

The final board meeting will consist of a review of the total project. Following the review, we will have a quiz.

ACTIVITY

Questions to be answered before the next class period.

1. What do you do when you are laid off?

____

2. How will you know your outside reading assignment?

____

3. What is the purpose of job specifications?

____

4. During what class period will the Vice President of Quality be selected? _________________________

DESIGN

OBJECTIVES

The student will be able to recognize:

1. The term market research and how it relates to the grill rake.
2. Function, appearance and workability as elements of design.
3. How the elements of design are applied to the design of the grill rake.
4. The alternatives available in redesigning the grill rake.

INTRODUCTION

Two things are important to understand before starting our design activities. We need to become familiar with market research. We need to understand some of the elements (parts) of design.

Market research. Before there can be a design, a product must be selected. Most ideas for manufacturing come from market research. Market research involves finding out what people want and what they will buy. This gives the manufacturer some idea how people will accept his product. It also indicates how a product might sell.

The decision to manufacture a grill rake came from a survey of seventh grade industrial arts classes. The students saw the need for a barbecue tool. Many ways could be used to spread the hot charcoals. Coat hangers, wood sticks could be used for the task. The survey indicated that a grill rake would be a good usable product. Thus, a product idea was born. (Fig. A).

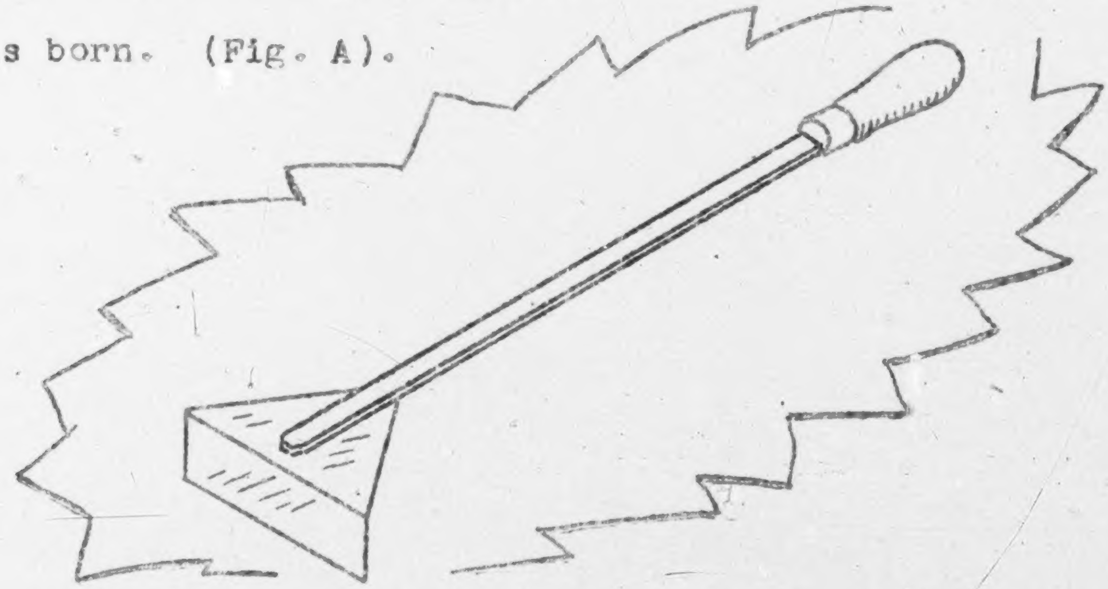


FIG. A. The Grill Rake: A Product Idea

Elements of Design. Some elements of design that we must consider are: (1) function; (2) appearance; (3) workability.

1. *Function*. A design is said to be functional, if it serves a useful purpose. The grill rake should move charcoal about properly. The coals should be moved about without burning the hands.
2. *Appearance*. Appearance is concerned with how the product looks. The grill rake should be appealing to the eye. The grill rake design should be simple but attractive.
3. *Workability*. The design should allow for ease in manufacturing. The making of the grill rake component parts should be easily done. The assembly of the grill rake parts should be quick and simple.

GRILL RAKE DESIGN ELEMENTS

The grill rake has three separate parts. They are the *blade*, *handle* and *grip*. (Fig. B).

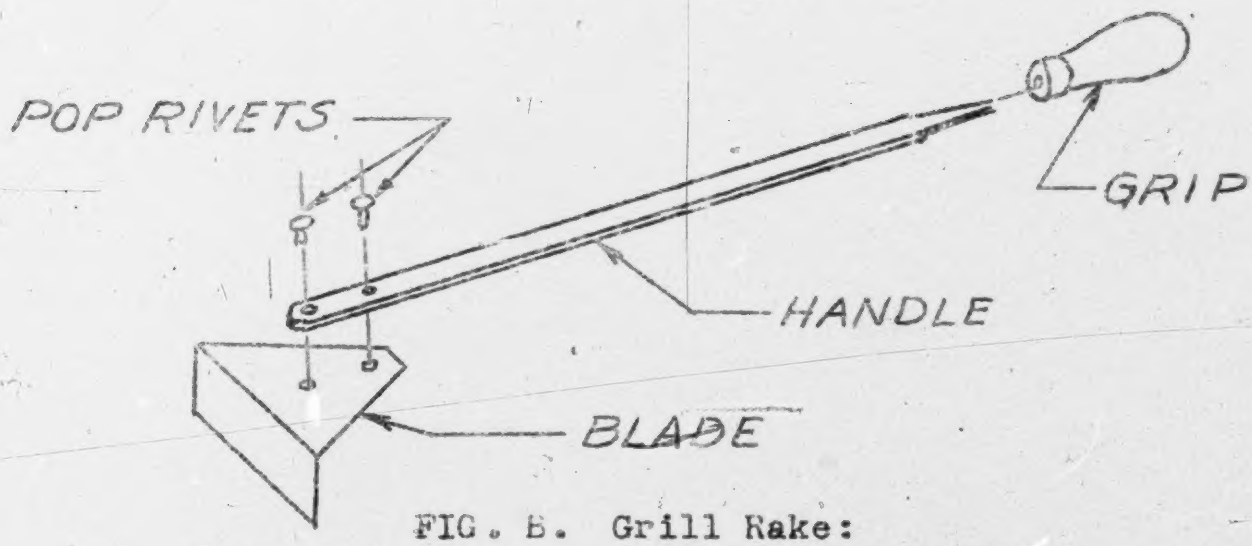


FIG. B. Grill Rake:
Three Main Parts - Grip, Handle and Blade

Blade. The shape of the blade should be simple. (Fig. C).

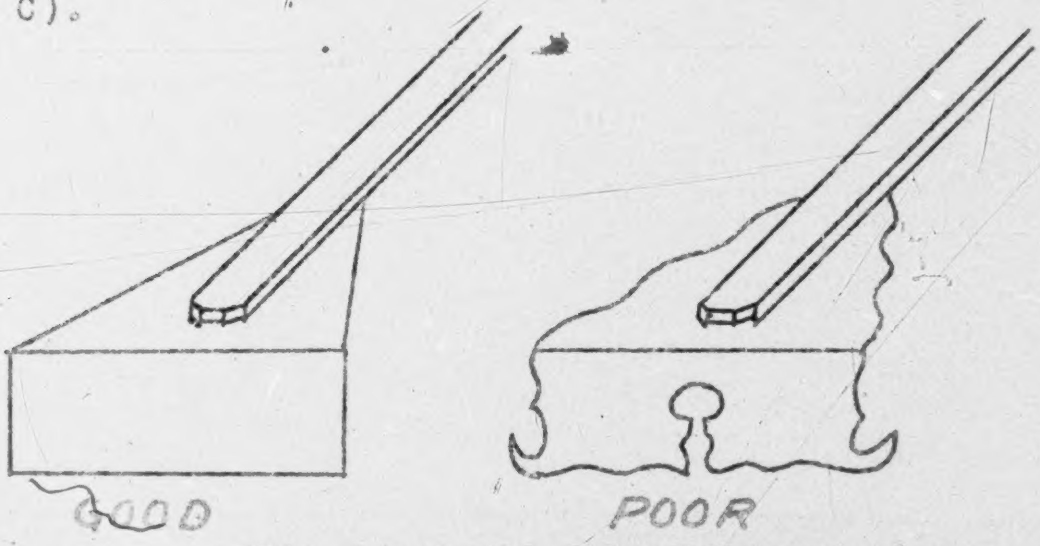


FIG. C. Grill Rake Design:
Functional and Simple

The blade should not be too large because it becomes difficult to use. The size of the blade should be large enough to move the coals about. The surface that is in contact with the coals should have the right depth and width. (Fig. E).

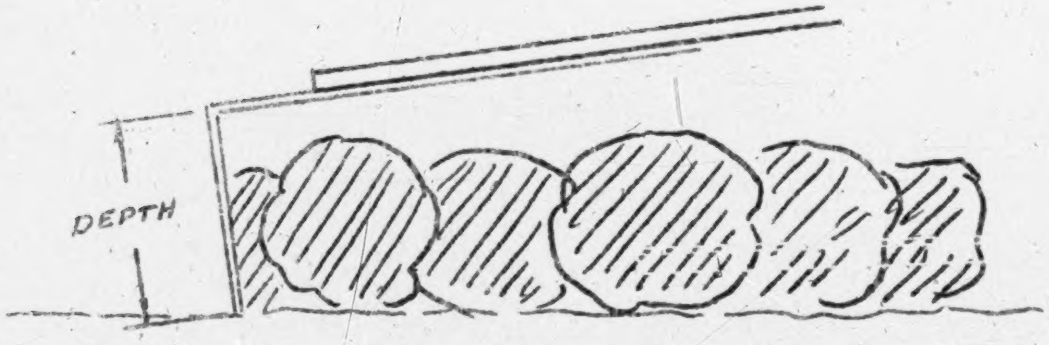


FIG. D. The Blade Depth:
The Height of the Charcoal

The material chosen for the blade is 24 gage galvanized sheet steel. Galvanized sheet steel is heat resistant (won't soften with heat). It resists rusting. The material is easily worked and is attractive.

Two holes will be drilled in the blade. The rivet holes must be in the center of the blade. (Fig. E).

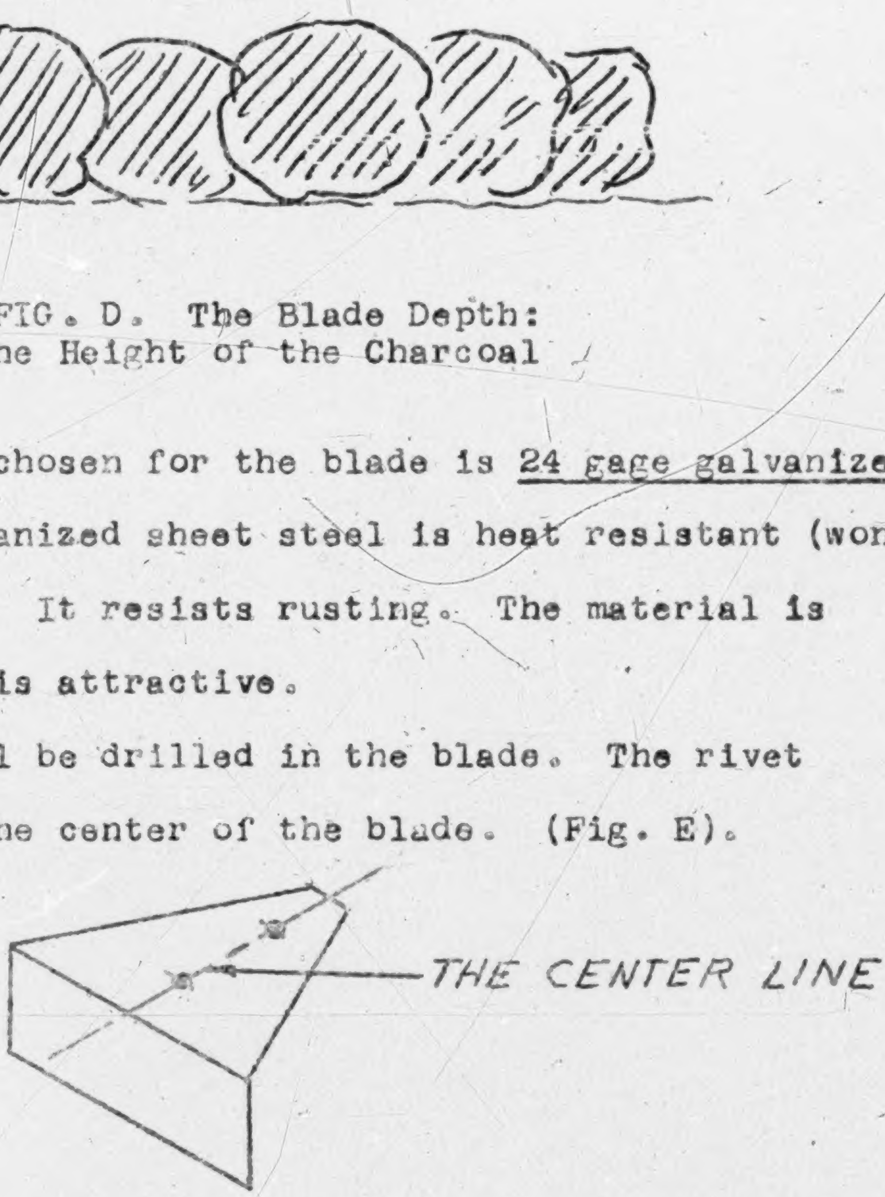


FIG. E. Drill Holes: Centered on the Blade

Handle. The handle must be long enough to reach the coals without burning the user. (Fig. F).

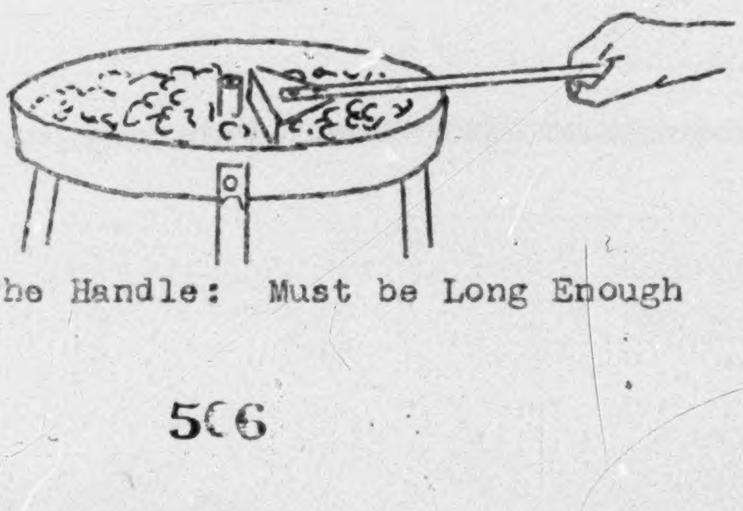


FIG. F. The Handle: Must be Long Enough

Hot rolled band iron is the material used for the handle. It is strong and easily worked. The material chosen is 1/8" thick and 1/2" wide. The handle material should not be too wide because it would make the handle look and feel too heavy. The handle would be too weak if it were too narrow. (Fig. G).

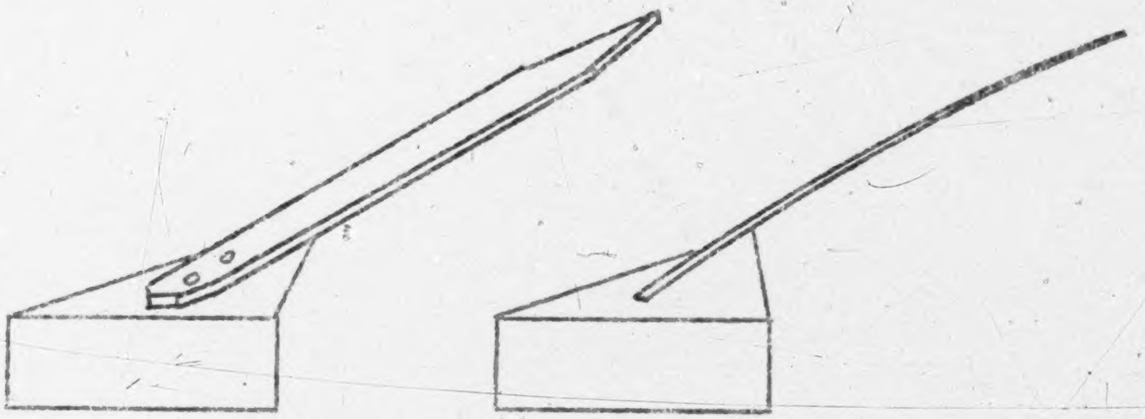


FIG. G. The Handle:
Must Not be too Wide or too Narrow

Two holes for riveting will be drilled at one end of the handle. These holes will match the holes in the blade. The other end will be pointed. The grip will be forced on this end. This is much like the tang on a file.

The handle will be finished (painted). It could be finished with an enamel, house paint or colored lacquer. It also could be appled by brushing, dipping or spraying. The finish on the handle should dry quickly (because of shop dust). The finish should be easy to apply. A quick drying spray finish will be used. The color should be bright so it can be seen if dropped in the grass. Red spray will be the finish that will be applied to the handle.

Grip. A grip is to be placed on the pointed end of the handle. The grip should be made of wood. It will prevent burning of the users' hands. The grip could be manufactured in our laboratory. The grip may also be purchased. Because of time, we will buy the grip. A file handle will make a good grip. File handles are usually made of wood. They will fit the point of the handle. They are inexpensive. The file handle to be used as a grip will be purchased as a component for assembly.

Assembly. The handle and blade are to be fastened together with rivets. The fastening is to be strong and permanent. To meet this need, several types of rivets could be used. Soft round head iron rivets, tinners rivets and pop rivets could be used. Because they speed up riveting, pop rivets will be used. Pop riveting is a variation of the ordinary rivet that is used in assembly work. In assembly, the handle is placed on top of the blade. (Fig. H).

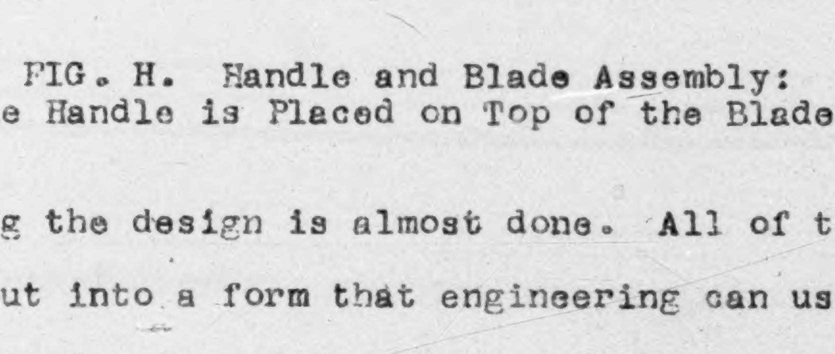


FIG. H. Handle and Blade Assembly:
The Handle is Placed on Top of the Blade

Planning the design is almost done. All of these ideas have to be put into a form that engineering can use. This means making a drawing of the parts and the specifications. (Fig. I).

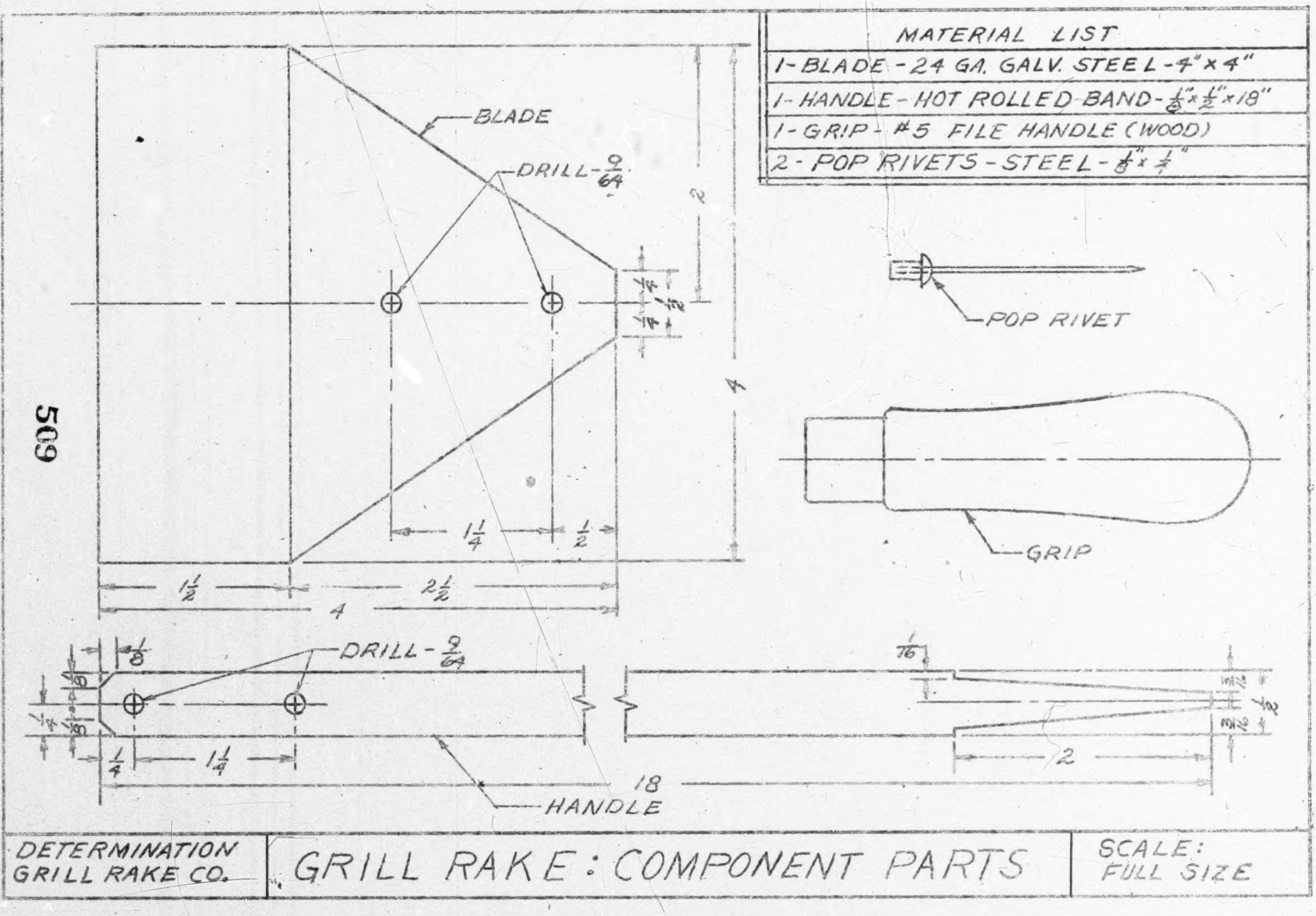

MATERIAL LIST
1-BLADE-24 GA. GALV. STEEL-4"x4"
1-HANDLE-HOT ROLLED BAND-1/8"x1/2"x18"
1-GRIP-#5 FILE HANDLE (WOOD)
2-POP RIVETS-STEEL-1/8"x1/4"
BLADE
DRILL-9/64
POP RIVET
GRIP
2
4
1/4
1/2
1 1/4
1 1/2
2 1/2
DRILL-9/64
1/8
1/16
3/16
18
HANDLE
DETERMINATION GRILL RAKE CO.
GRILL RAKE: COMPONENT PARTS
SCALE: FULL SIZE
2.7

FIG. I. Grill Rake: Component Parts, Drawings & Specifications

DESIGN ALTERNATIVES

Up to this point, you have had little choice in the selection of the product or choice of design. One assignment of the design department will be to redesign (rework design) one part of the grill rake. Some alternatives (other ways of doing) will be given to help you in redesigning.

The rake could be altered in several ways. Tines could be included in the design. (Fig. J).

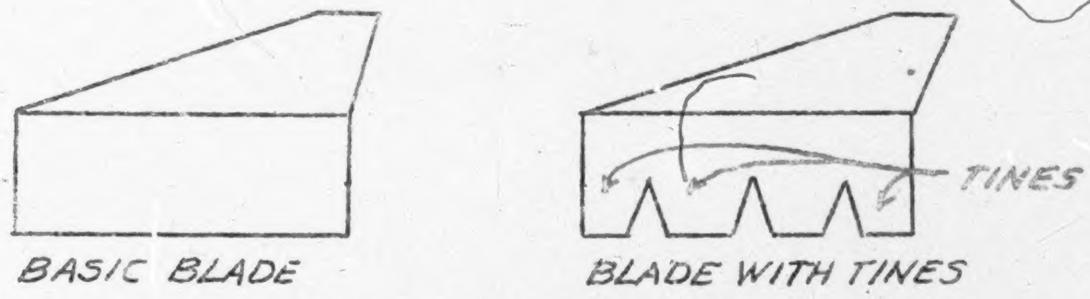


FIG. J. The Blade:
Redesigning by Adding Tines

The basic rake shape could also be changed. This can be done in a number of ways. (Fig. K).

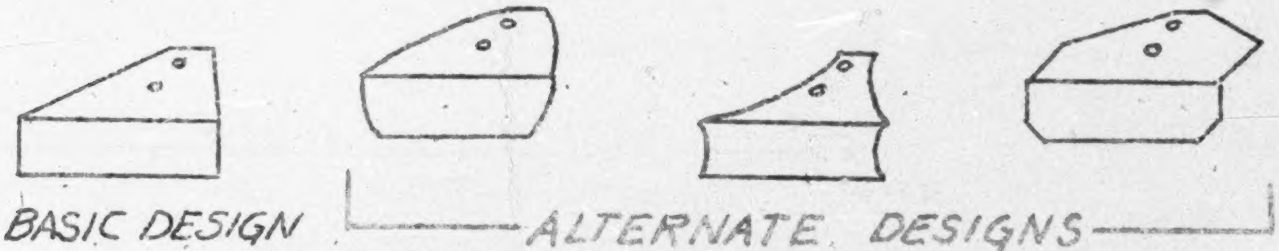


FIG. K. The Blade:
Redesigning the Shape

In design, no one way is entirely correct. It becomes the task of the designer to choose the design that most nearly meets the needs.

The handle could also be redesigned. The basic shape can be changed. Instead of a straight band, twists in the handle can be made. This will tend to make the appearance of the band less monotonous (without change). (Fig. L).

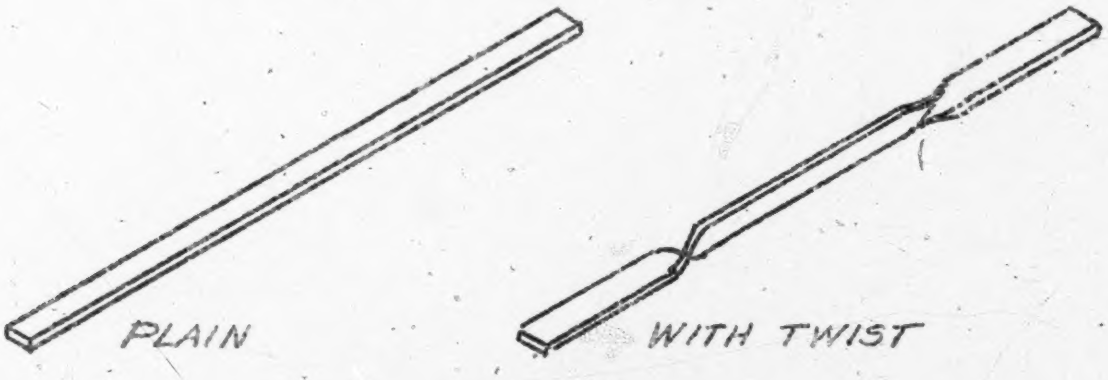


FIG. L. Handle Design:
Adding Interest to a Metal Band by Twisting

There are many ways in which the handle may be twisted. One activity of the design department will be to redesign the handle by adding twists.

SUMMARY

Design plays an important part in the manufacturing process. It is one of the beginning steps in the manufacture of a product. The design must be functional. The design must be attractive. The design must be workable.

Ideas for a product most often come from market research. In the selection of a product, many design elements must be considered. In the selection of the grill rake, many questions concerning shape and size, material, fasteners, finishes and the grip had to be answered.

Most designs will have alternatives that must be considered. The grill rake allows for many alternative designs.

LABORATORY ACTIVITY

Objectives

The student will:

1. Make several drawings to show a change in the design of the handle.
2. Make a prototype of the grill rake.
3. Answer questions concerning the written text material.

Activity

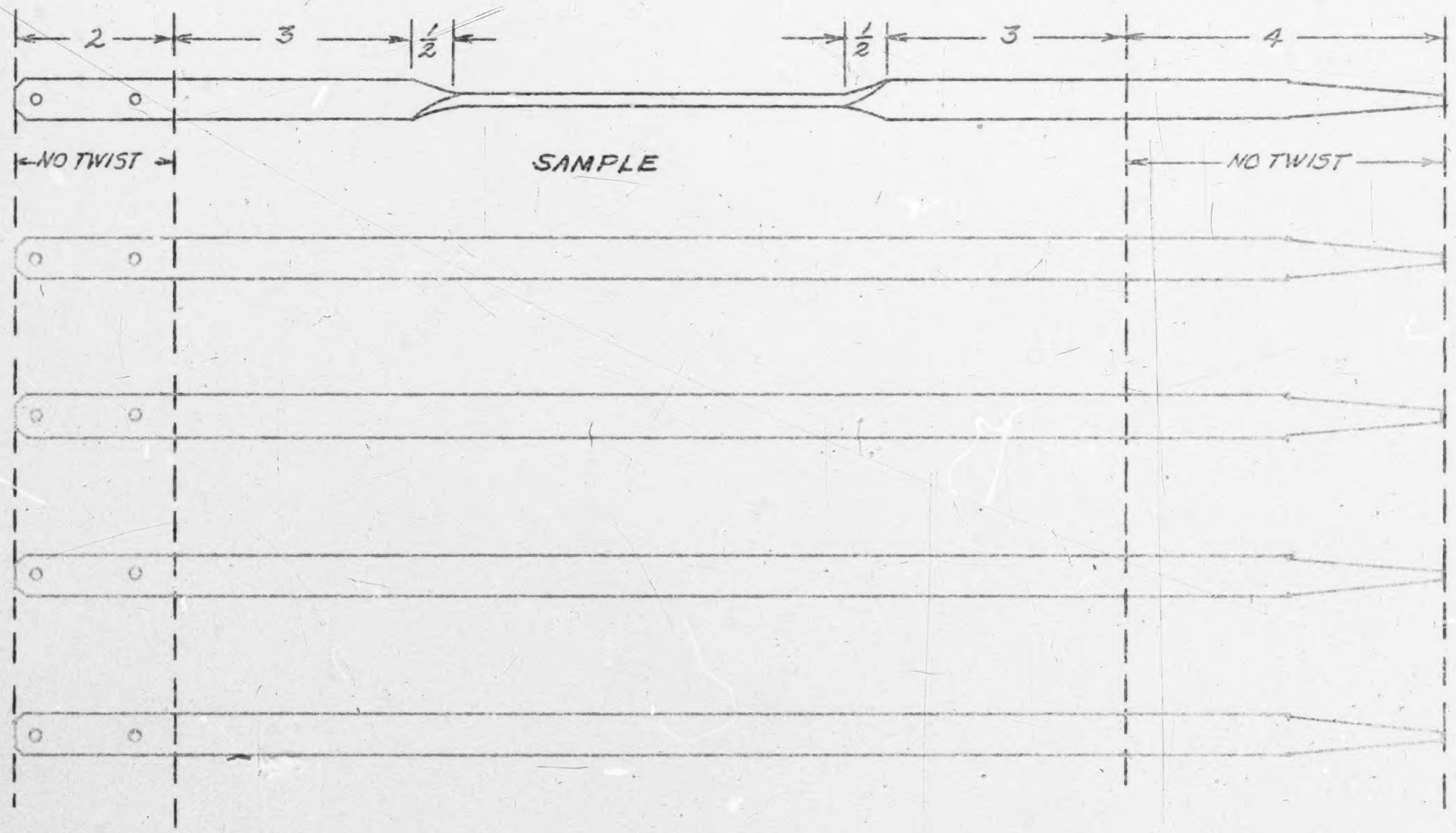
Part I - Read the unit on "Design".

Part II - Redesigning the Handle by Twisting. Each member of the design department will make four separate sketches. You will make the necessary twists. The twists should be at least 2 inches from the ends of the band. Do not consider the tang as the end of the band. (Fig. M).

Part III - Grill Rake Prototype The design department will be responsible for making a prototype (an exact replica) of the grill rake. The Vice President of Engineering will get your materials. The prototype will be hand made. You will not use jigs or fixtures. The redesign of the handle will be included. The prototype has to be exact in every detail. This will be done after the redesigning of the handle is completed.

Part IV - Review Questions

1. What is market research?
2. List the three elements of design.
3. What material is used for the blade? What material is used for the handle? How long is the handle? What is the size of the blade?
4. Why were rivets chosen to fasten the handle to the blade.


2
3
1/2
1/2
3
4
NO TWIST
SAMPLE
NO TWIST

DETERMINATION GRILL RAKE CO.	DATE:	HANDLE REDESIGN	PREPARED BY:	CHECKED BY:

FIG. M. Handle Redesign: Make Four of Your Own Changes

PLANT LAYOUT

OBJECTIVES

The student after studying this unit should be able to:

1. Develop facilities (equipment and space) for the manufacture of the Bar B Que Grill Rake.
2. Promote effective use of manpower.
3. Provise convenience, safety and comfort for the worker during the manufacture of the grill rake.

INTRODUCTION

The basic factors that affect the Grill Rake plant layout are: (1) The design of the product. (2) The tools and machines needed. (3) The manufacturing procedure.

Product Design If the product is large, heavy and involves many parts then it is reasonable to say that probably more space will be needed to manufacture it. Also large heavy parts create a handling (moving) problem. Small products can be handled quite easily along a production line.

Tools and Machines In the manufacture of most any product there is always a minimum amount of necessary equipment. Equipment needed to do the job efficiently. It must be decided what the minimum amount be for our grill rake. Will we need six drill presses to do our drilling operations? Or can the job be done efficiently with fewer drill presses?

PLANT LAYOUT

Manufacturing Procedure Manufacturing procedure referrs to the order of operations that are to be performed during the manufacturing process. The equipment (tools, machines and benches) will be located in such a way that our parts will flow from one operation to another. Materials should always flow to the end of the production line.

PLANT LAYOUT

The type of product also affects plant layout. Small, light products, such as our grill rake, can be moved easily. Thus we can give more attention to machine and work stations. Our product is small and simple so our facilities need not be elaborate.

Routing This term means to prearrange and direct the order for a series of operations. In other words let's think of the operations required to make the rake. Our plant layout will require two things. (1) Order of work operations to be done. (2) Tools and machines needed to do the work.

Supplying In the supply area we will cut the stock to the sizes needed. The band iron for handle will be cut to eighteen inch lengths. The sheet metal will be cut to four inch squares. From here the parts will move to the layout area.

PLANT LAYOUT

Our supplies will consist of:

1.	1/8 x 1/2" band iron	- for handle
2.	24 gauge galvanized sheet	- for blade
3.	1/8 x 1/4 long, pop rivets	- attach handle to blade
4.	#5 wooden file handle	- for grip

Laying-out Work Layout means to mark the parts to size and shape. We will be concerned with laying out the shape since we have just cut the parts to size. The location of the holes in both parts will be marked. The location of the bend will be marked at this time. From this station the work will be divided into two lines. Line (A) will be for the rake forming. Line (B) will be for the handle operations. Later on the two parts come together in a single line for assembly.

Cutting to Shape The handle will need to be cut to shape. The blade will need to be cut to shape. A hacksaw will be used to cut the tang (pointed end) on handle. A pedistal grinder will be used to shape the other end of handle. The squaring shear will be used to cut the blade.

Drilling All drilling operations will be done with a drill press and electric hand drill. We will use the drill press for the handle drilling. An electric hand drill will be used for the blade.

Grinding Both ends of the handle will be ground. The tang end needs to have the burrs removed from the

PLANT LAYOUT

sawing operation. The other end will be ground to shape as shown on drawing.

Burring This operation will be to remove all rough and sharp edges from the parts. A file will be used to remove all burrs.

Bending A 90 degree bend will be made on the blade. This bend will be made on the box pan break (a sheet metal forming machine). The machine will be pre-set for the correct angle, etc.

The twist on the handle will be done in a vise with the aid of an adjustable wrench and a piece of tubing.

Painting The handle will be spray painted. Quick drying lacquer in an aerosol can will be used. Therefore the painting operation will not slow down the flow of parts along the assembly line.

Assembling The two lines now come together. The handle and blade are attached. A pop riveter will be used for this operation.

The wooden grip is also attached at this point. The grip will be forced onto the tang by bouncing the grip on a wooden block.

Final Inspecting The Bar B Que Rake is now completed. A final inspection is now made to check for two things. One is surface flaws. The other is looseness of grip and blade on handle.

PLANT LAYOUT

If defects are found the product will be scrapped or sent back up the line to a proper place for rework.

Packaging The finished product will be wrapped and placed in a cardborad box for storage and shipping. The worker placing them in the box will also keep a tally of the number of rakes packed.

SUMMARY

We started with a given number and size of stock. These pieces of material were cut to exact shape, drilled, ground and burred. The parts were bent and painted as to the drawing specifications. As the parts moved along the line they were assembled, inspected and packaged.

The parts moved from a starting point through a series of stations and finally ended up as a finished product. A flow chart (map of plant layout and order of operations) has been made up for this product. (Fig. A).

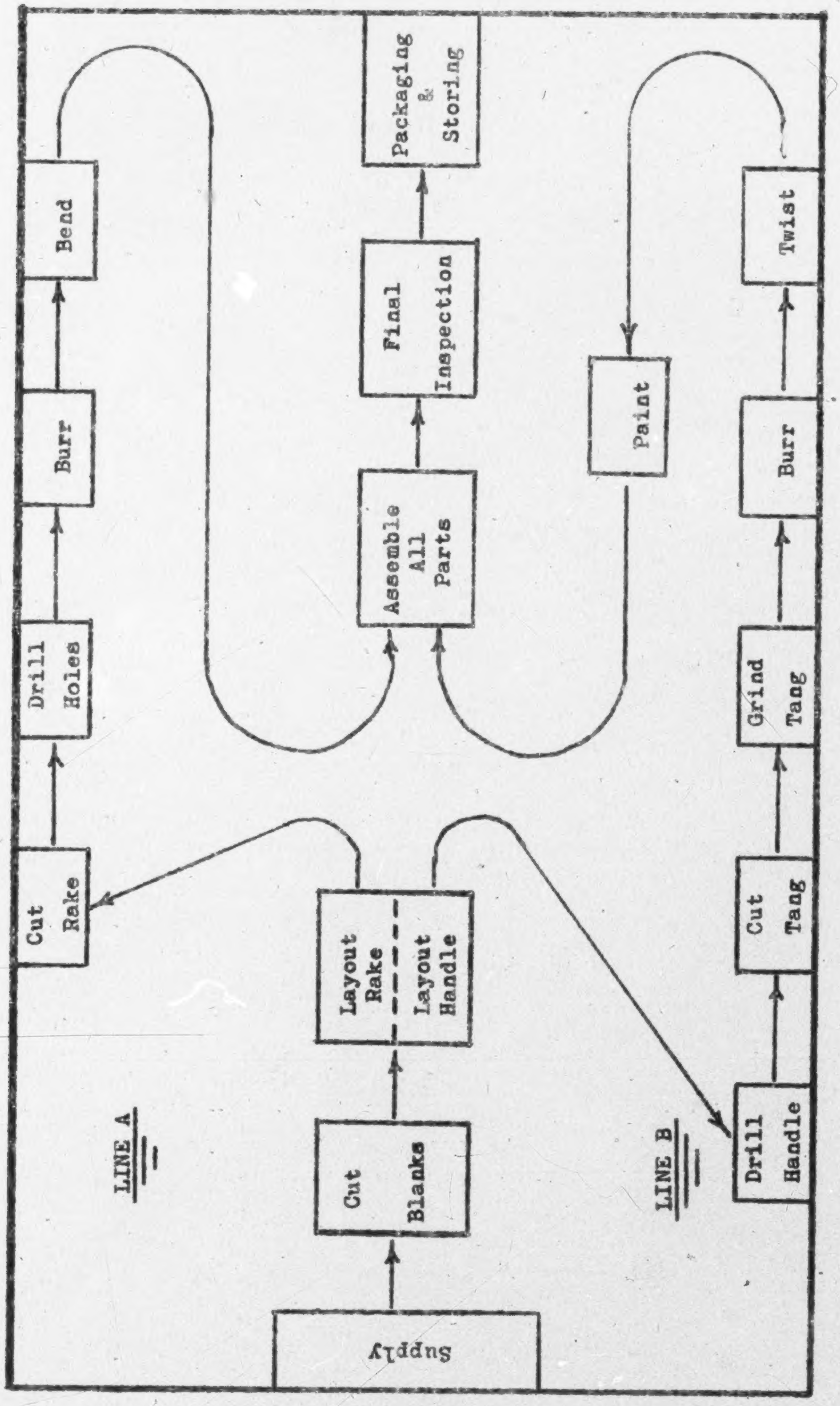

LINE A
LINE B
Supply
Cut Blanks
Layout Rake
Layout Handle
Cut Rake
Drill Holes
Burr
Bend
Drill Handle
Cut Tang
Grind Tang
Burr
Twist
Paint
Assemble All Parts
Final Inspection
Packaging & Storing

FIG. A Flow Chart For Manufacturing Grill Rake

PLANT LAYOUT

LABORATORY ACTIVITY

Objectives

1. To make economical use of the floor area when setting up a production line for the grill rake.
2. To minimize materials handling while the rake is being produced.
3. To set up a production line for the grill rake using our shop facilities.

Introduction

Now that we have read and discussed the principles of plant layout let us concentrate on setting up our shop to manufacture the grill rake. Keep in mind that the order of operations, tools and machines affect the flow of materials along the production line.

Procedure

You will receive a sheet showing the present layout of our shop. Most of our machines are fastened to the floor. The benches can be moved if necessary. Extra tables may be brought in if needed. Our drill press and grinder could be mounted on a piece of plywood (so they will not tip over) and moved from their present location. Hand tools may be placed along the line where needed.

Set up your line so that the materials are always moving toward the finished end. Do not crowd the facilities to the extent that you create safety hazards. Allow enough room around machines. Avoid long distance moving of materials from one operation to another.

Materials Needed

Notebook - Pencil - Ruler - Copy of our present shop plan

Activity

In your Industries notebook sketch or draw a flow chart for manufacturing this grill rake in our shop. Remember it will probably be necessary for you to make some changes in our floor plan.

JIGS and FIXTURES

OBJECTIVES

The student will be able to:

1. Determine the difference between the use of a fixture and a jig

2. Solve a holding and/or drilling problem

3. Construct a jig or fixture

4. Determine when the use of a jig or fixture is necessary

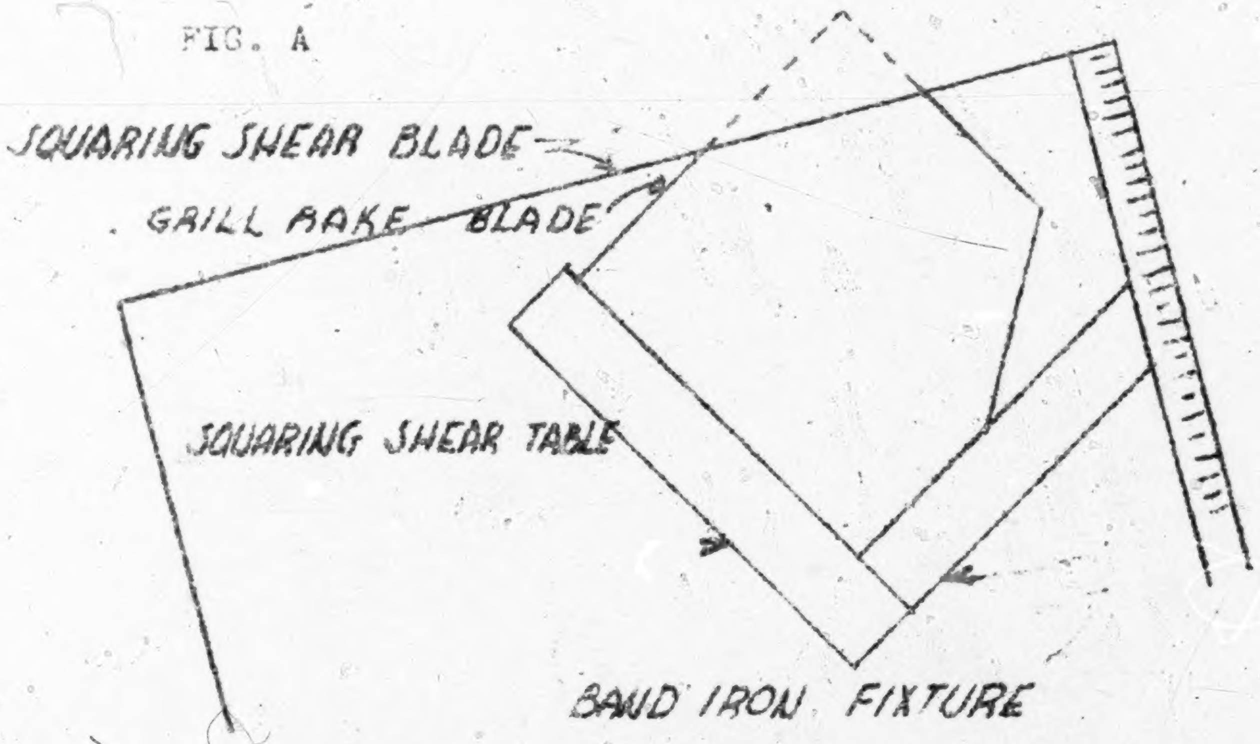
INTRODUCTION

Mass production is the method used by the manufacturer to inexpensively produce large numbers of the same product. A manufacturer selects a product to manufacture. A market analysis indicates that the consumer may buy five-hundred of these products. The assembly line is set up to make each part of the product. Each part or operation is made five-hundred times. Sometimes these operations may be only holding or drilling five-hundred like parts. A worker may design and make a tool to hold and drill one part correctly. This tool is used to hold and drill the other four-hundred and ninety-nine parts. This saves time. The worker has constructed a jig and fixture.

FIXTURES

A fixture is a holding tool. It locates the part and keeps it from moving. In the production of the grill rake it is necessary to taper the sides of the blade. A tool to hold the blade while it is being cut is necessary. Two things are needed in the design of a good fixture for the grill rake. They are: (1) how well the fixture holds and locates the blade of the grill rake (2) how accurate the taper is cut using the fixture as a guide. A fixture may be constructed very simply. (fig. A)

FIG. A



This fixture is made of three pieces of band iron at right angles to each other. Cut at the proper angle, the fixture is attached to the squaring shear table. The grill rake may now be cut quickly and accurately. Many blades may now be cut. This is mass production.

JIGS

A jig is a guide tool. It guides the tool to the work. In the mass production of the grill rake two holes are needed in the rake handle and two in the blade. The holes in the blade match the holes in the handle. To drill these holes quickly and accurately a jig is made. (figs. BandC)

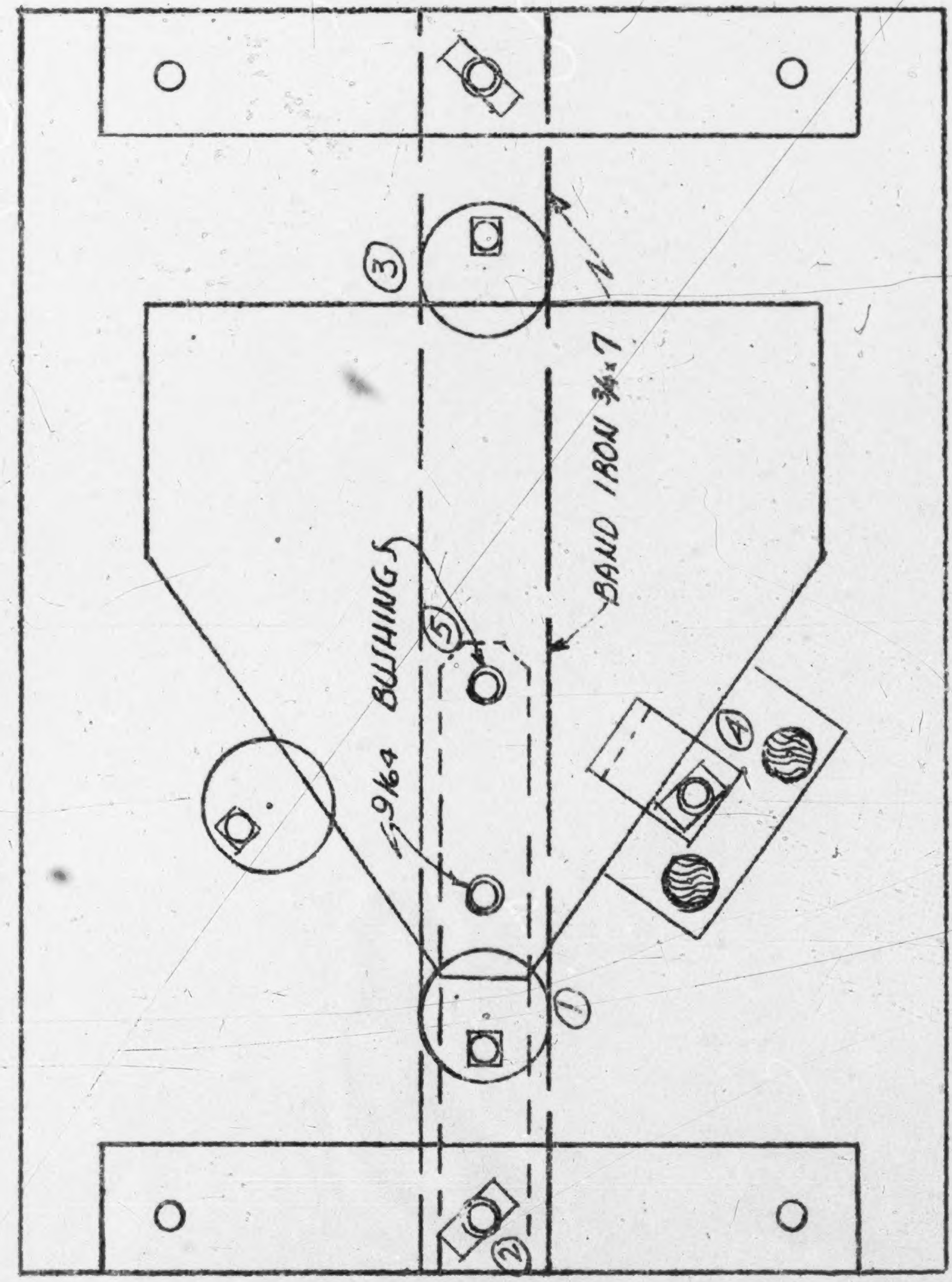

③
BAND IRON 3/4 x 7
BUSHINGS
⑤
9/64
④
①
②

FIG. B

4:4

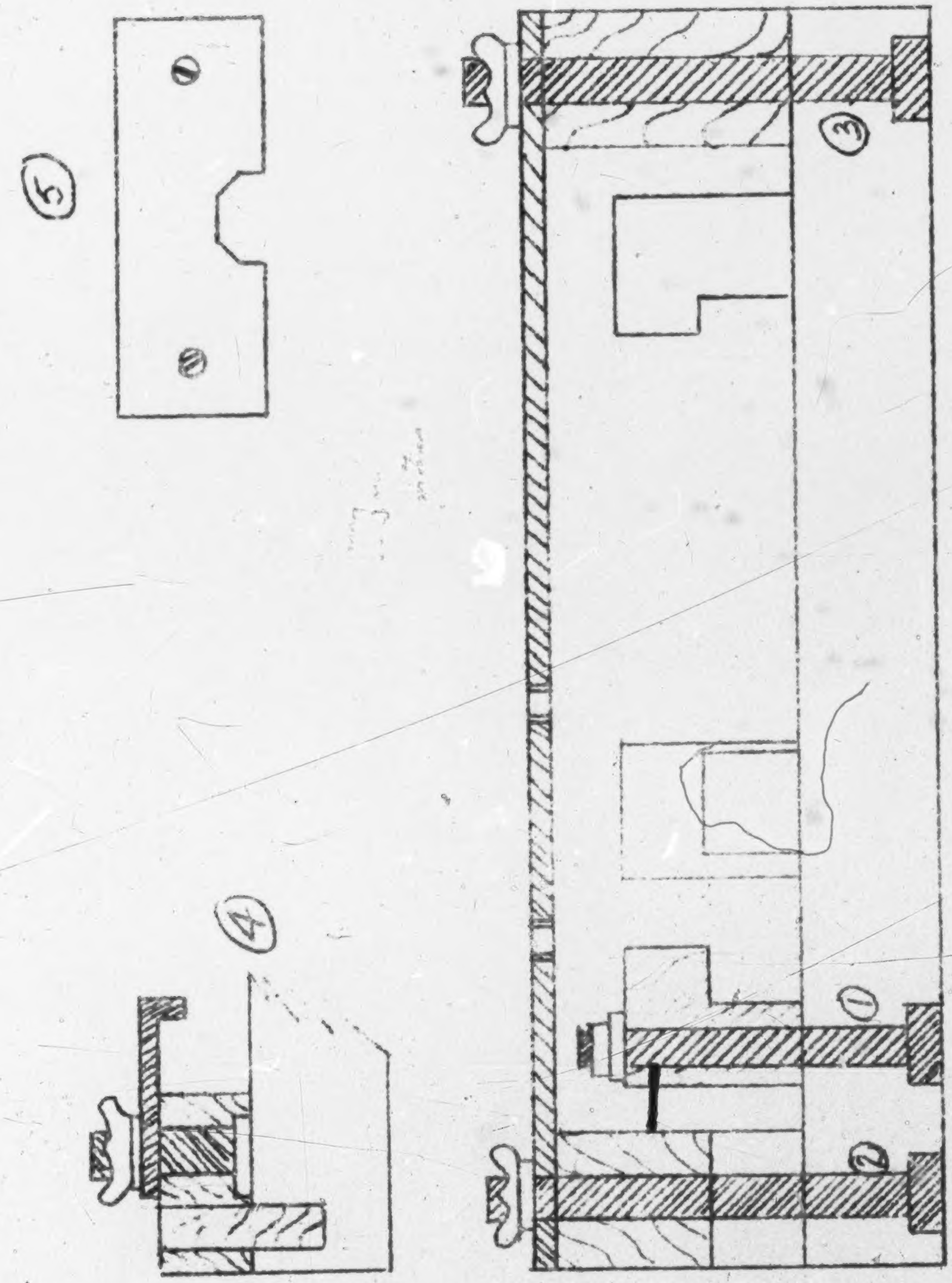


FIG. C

Most jigs are made of cast iron or rolled steel. For the purpose of producing the grill rake, 7/8 hard wood is used for the body of the jig. For the pins, which locate the blade and handle, 3/4 dowels are used. The clamp is made of a bolt, washers, wing nut, 1/4 dowel, and a small piece of band iron. The clamp gives added holding power.

The bushings(removable metal linings) guide the drill to the handle and blade. They are located in the band iron at the top of the jig. The holes in the blade are drilled first. The dowels are then adjusted in the body of the jig to recieve the handle. The handle is drilled using the same bushings.

SUMMARY

A fixture is a holding tool. Jigs are fixtures made to guide the tool. Jigs and fixtures are made strong. They are time-savers in mass production. Some parts of a jig are bushings, clamps, and pins. Many materials are used in making jigs and fixtures. Cast iron and rolled steel are frequently used. "COMMON SENSE" is the key word in making a jig or fixture.

LABORATORY ACTIVITY

Objectives

The student will be able to:

1. Sketch a simple jig or fixture for a grill rake
2. Construct and test a simple jig or fixture for a grill rake

Materials

1 black iron(as needed)
1(bx)stove bolts ¼ x 2 1/2
1(bx)nuts(square and wing¼)
2(lgth)dowels(3/4 and 1/4)
band iron(as needed)
1(pkg) graph paper
4 pencils
4 erasers
4 rulers
1(bx)steel washers(¼)

Equipment

2 wrench, adjustable
1 saw, hack
1 bit, forstner
3 drill, twist(1/4, 3/4, 1/2)
1 press, drill
1 saw, back
2 screwdiver

Design Day

There are four students in the jig and fixture group. A half of a period is spent on designing a jig and fixture. Two students are given the problem of designing a fixture for the cutting of the grill rake blade to shape. The other two students are given the problem of designing a jig for the holes in the rake blade and the rake handle. As a guide and a learning experience the students examine and disassemble the actual jig and fixture previously constructed. The students use graph paper, rulers, and pencils for the design. Drawings are to be freehand sketches. Steps the student follows are:

1. Examine jig and fixture
2. Note changes needed
3. Write suggested changes on back of paper
4. Sketch ideas on front of paper
5. Hand in to instructor

Construction Day

A period and a half is spent on this phase. During this time the fixture and jig group constructs the tools they have designed. Using scrap wood and metal, dowels, screws, bolts and nuts, and any other available material the student makes the jig and fixture. Accuracy and ruggedness are very impotant. Steps the students follow are:

1. Secure material needed
2. Cut, drill, and measure to size
3. Assemble component parts
4. Check for accuracy

Testing Day

One half of a period is spent on testing the jig and fixture for accuracy and ruggedness. Several parts are drilled and cut using the students' jig and fixture. The students check each part for sameness of dimensions. They note the errors and adjust the jig and fixture, if necessary. Steps the students follow are:

1. Make six duplicate parts using the fixture
2. Measure each part
3. Adjust fixture, if necessary

1. Drill six duplicate parts using the jig
2. Measure distance between holes of each part
3. Adjust jig, if necessary

Note bene: If students' jig or fixture turns out to be better than the one previously constructed, use it.

THE PERSONNEL DEPARTMENT

DETERMINATION GRILL RAKE COMPANY

OBJECTIVES:

The student after studying this unit should be able to understand that the PERSONNEL DEPARTMENT;

1. WRITES a hiring policy containing the rules and regulations of the company.
2. USES a written application form in helping select the workers.
3. INTERVIEWS people to see if they are suitable for the job.
4. ANALYZES the application form and the interview form to place ~~the man on the~~ job.
5. REVIEWS each and every worker while he is working.

INTRODUCTION

The personnel department is necessary for the successful operation of the DETERMINATION GRILL RAKE COMPANY. This department is made up of people who supervise and record certain definite activities of the workers in the company. (Fig. A.)

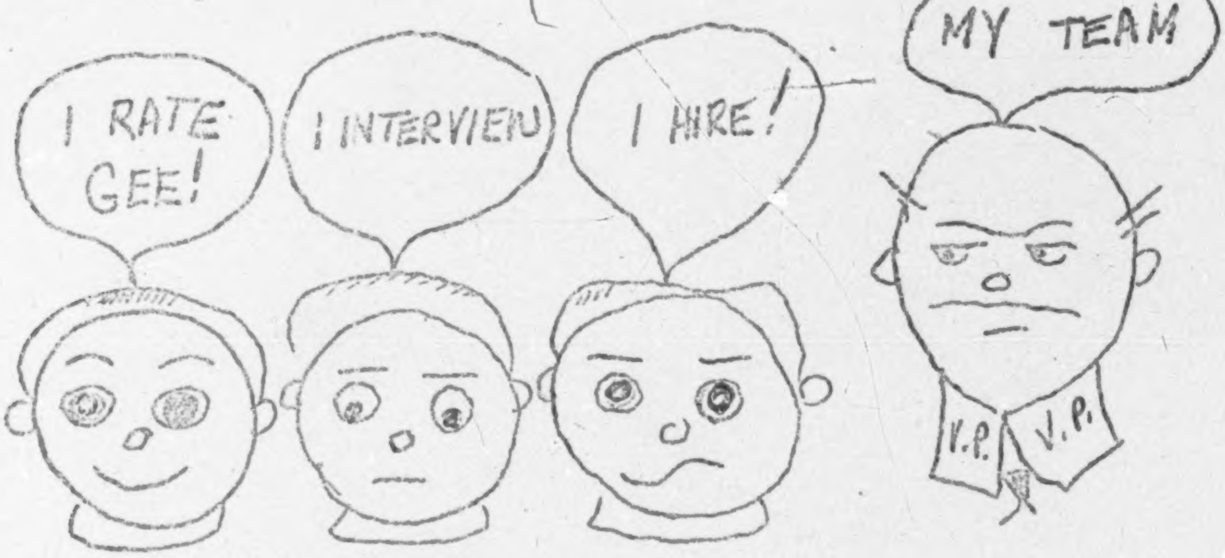


Fig. A. The personnel "crew"

The activities the personnel department is concerned with are:

1. Developing and writing the production personnel forms used in the plant. They are the (1) policy form, (2) hiring form, (3) interview form, (4) job analysis form and (5) rating form.
2. Working with the various vice-presidents in selecting the correct people for the right production job. This is team work between the personnel department and the vice-presidents.
3. Reviewing the information on the different personnel forms to FIT THE MAN TO THE JOB.

The personnel department exists because the company needs a plan of action about the worker and his job. Let's put our personnel organization to work in the Determination Grill Rake Company.

PERSONNEL FORMS

1. POLICY FORM - The company must have certain rules on hiring before anyone can be placed on the "payroll". Our company has a list of policies and rules which need to be put into action by the Personnel Department. The vice-president in charge of personnel will sit down with his three member team and the people in top management to formulate the policies of the company. This is a combined effort between all the management personnel and the personnel department.

The personnel VP (vice-president) will add up all the votes, and the choices which receive the majority of YES votes will become the OFFICIAL company policy. A copy will be given to all employees. (Fig. B.)

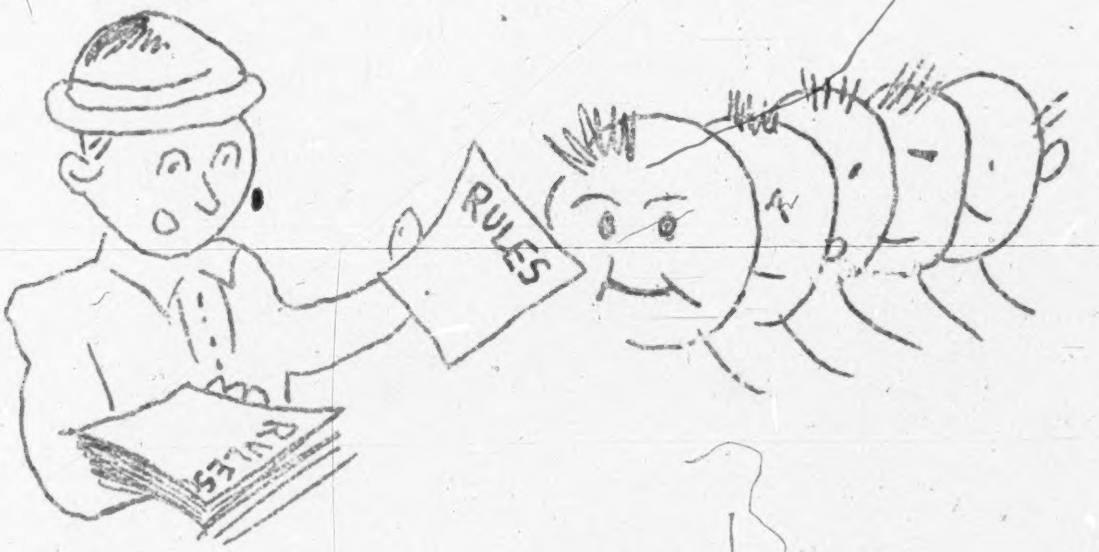

RULES
RULES

Fig. B. Everyone gets a copy of "Company Policy."

2. APPLICATION FORM (hiring) - The company needs workers. Jobs require workers. What are the jobs now waiting to be filled at the Determination Grill Rake Company? (Fig. C.)

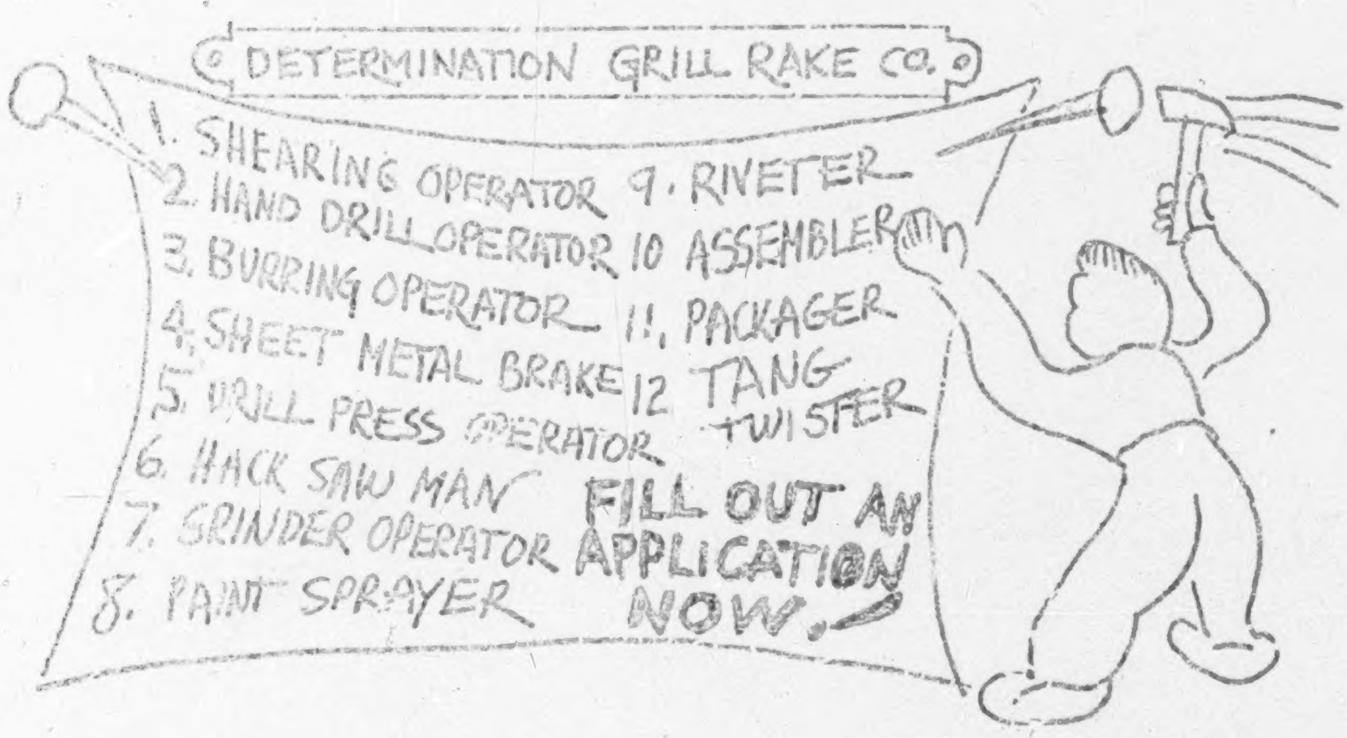

DETERMINATION GRILL RAKE CO.
1. SHEARING OPERATOR
2. HAND DRILL OPERATOR
3. BURRING OPERATOR
4. SHEET METAL BRAKE
5. DRILL PRESS OPERATOR
6. HACK SAW MAN
7. GRINDER OPERATOR
8. PAINT SPRAYER
9. RIVETER
10 ASSEMBLER
11. PACKAGER
12 TANG TWISTER
FILL OUT AN APPLICATION NOW!

Fig. C. Jobs are posted.

Knowing the jobs available, the personnel team will distribute the application forms to all class members to be filled out as soon as possible. (Fig. D.)

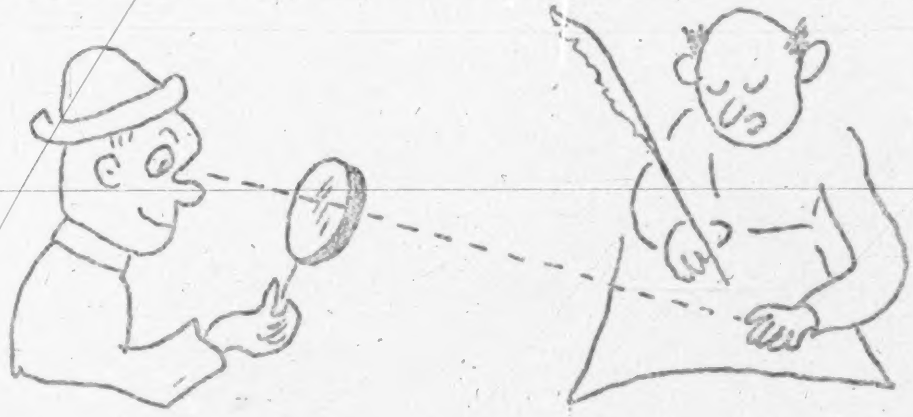


Fig. D. "Help him - don't spy on him."

Team members might assist others in filling out the application. When finished, the forms are collected for the next step in the selection process.

3. INTERVIEWING FORMS - The personnel team will conduct interviews with the class members about the positions for which they are applying. Each of the four members of the personnel team will talk to one class member at a time. (Fig. E.)

YOU'RE HIRED!

Fig. E. A good appearance is important.

The interviewer will talk about the information on the application with the prospective worker. Immediately after the talk with the applicant, the interviewer will fill in the interview form. This will be stapled to the application form and then filed in the personnel records.

4. PLACEMENT FORMS (job analysis) - The personnel team must know the exact job to be filled and all the requirements needed of the worker in doing the job. The Personnel Department gets the information for the job analysis forms from the department that needs the workers. (Fig. F.)

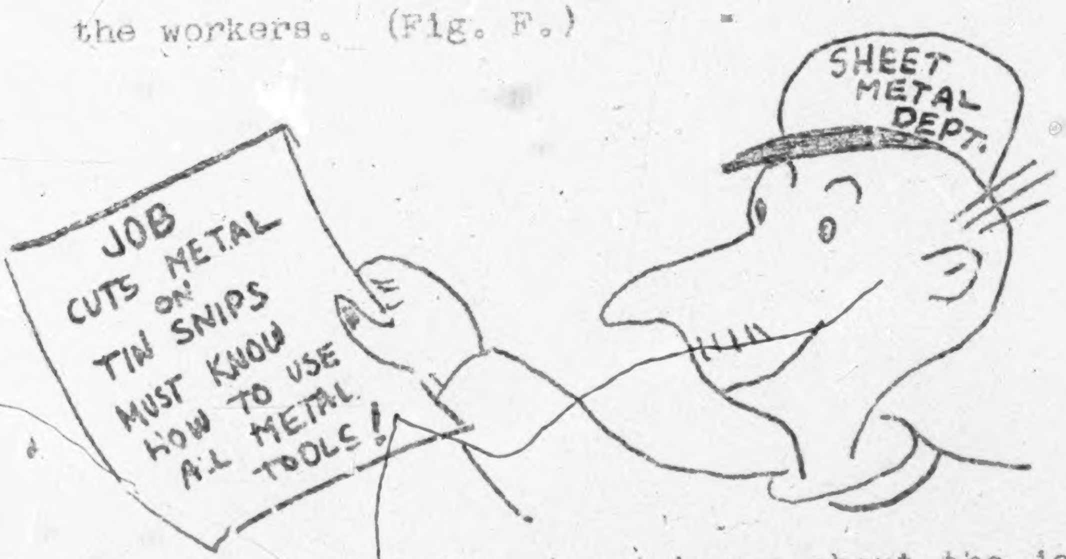

SHEET METAL DEPT.
JOB
CUTS METAL ON TIN SNIPS
MUST KNOW HOW TO USE ALL METAL TOOLS!

Fig. F. The Sheet Metal Department knows about the job.

The Determination Grill Rake Company has thirteen job openings. The Personnel Department will sit down as a team and:

- a. Look at the application form.
- b. Study the interview form.
- c. Examine the job analysis form.

Considering all the information on the forms, they will select the person for the job to be filled.

The personnel team might like to:

- a. Talk again with the applicant.
- b. Confer with top management.
- c. Discuss the job with the department heads.

Picking the right man for the right job is the most difficult single item of work for the personnel team. This requires time, thought and responsible effort if the operation of The Determination Grill Rake Company is to be successful. This job is no joke!

5. RATING FORMS - When production starts the personnel team will be reduced to one man - the other three people are in production. This person will discuss with each individual the work that he is doing. During the talk, the employee rating form will be on the table for both to see. Each item will be mentioned one at a time and the personnel man will encircle the item on the paper that is agreeable to both. (Fig. G.)

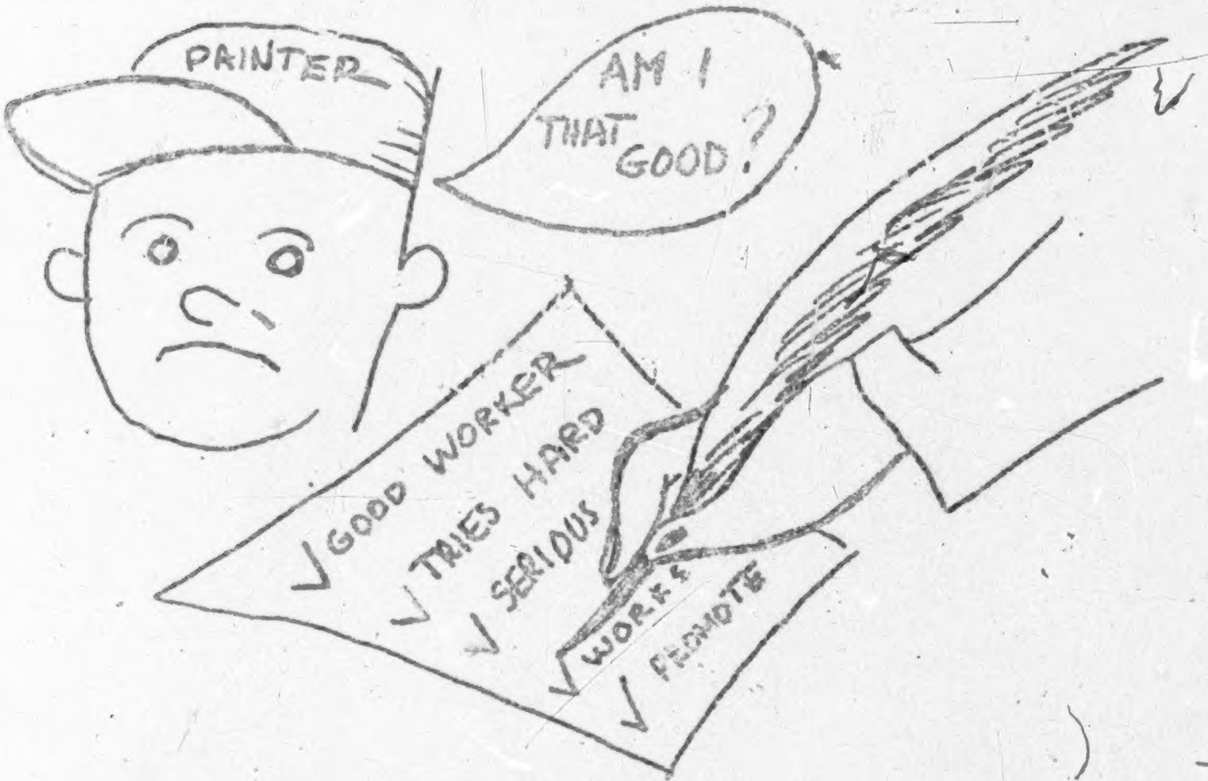


Fig. G. Both persons know the rating.

This process will be repeated for all the employees of the company. Upon completion, the rating sheets will be given to the teacher.

SUMMARY:

The Personnel Department of the Determination Grill Rake Company is a busy and active organization. The company motto is "Grill Rakes - Our Specialty." The Personnel Department is determined to make our company a success. Why? Because our workers are doing the job best suited to them.

The interviewing, the hiring, the placing, the rating and the company policy making - these are the prime concerns of the Personnel Department. (Fig. H.)

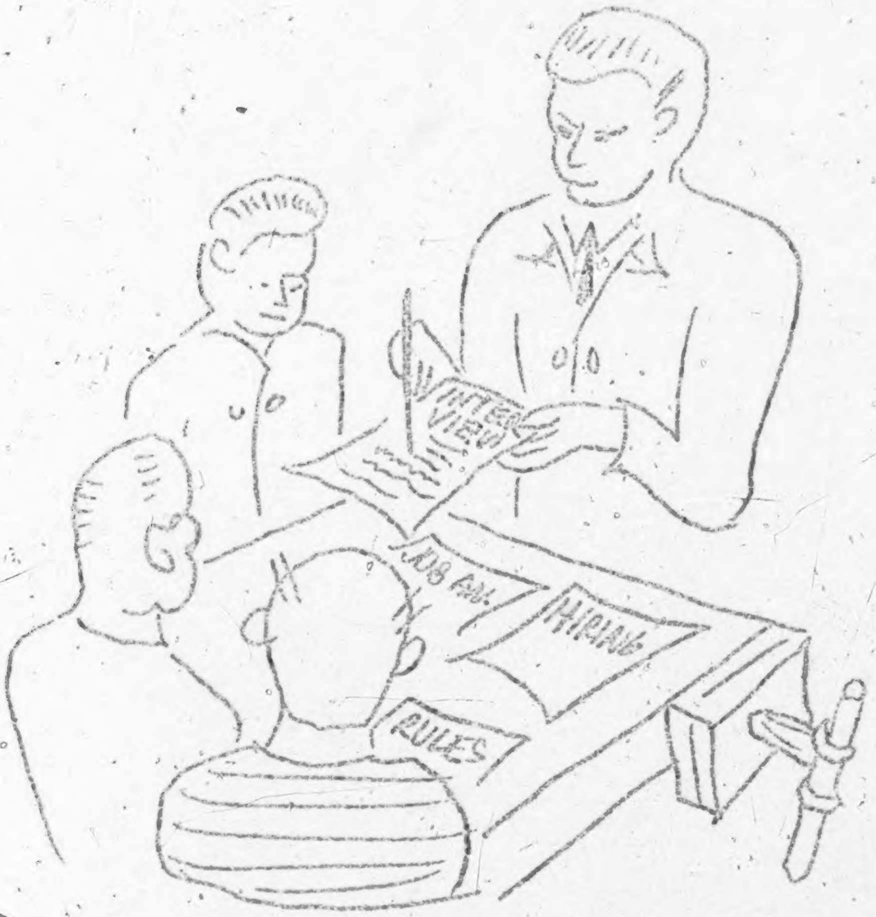


Fig. H. Concerns of the Personnel Department.

PERSONNEL DEPARTMENT

HIRING POLICY
&
RULES AND REGULATIONS

The PERSONNEL DEPARTMENT along with TOP MANAGEMENT
DECIDES the HIRING POLICY and the RULES
and REGULATIONS

(circle your choice)

HIRING POLICY

Must be able to use hand tools------------yes no

Must be able to use power tools-----------yes no

Must be able to read blueprints-----------yes no

Must have completed the 6the grade--------yes no

Must have 6 weeks of Industrial Arts------yes no

Must be in good health--------------------yes no

Others-write in here ____________________________

____

RULES AND REGULATIONS

No gum chewing----------------------------yes no

No horse play in the shop-----------------yes no

Safety glasses in the shop----------------yes no

Aprons worn in the shop-------------------yes no

No one permitted to leave shop during work-yes no

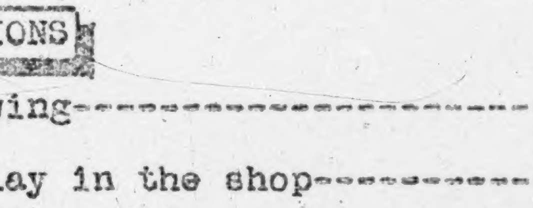
No violation of safety rules allowed------yes no

No disrespect for authority---------------yes no

No carelessness or poor workmanship-------yes no

No absenteeism or tardiness---------------yes no

No"breaks"during work---------------------yes no



Feet Tired?

PERSONNEL DEPARTMENT

EMPLOYEE APPLICATION FORMS

Name ______________________________

Address ______________________________

____

Height ____________ Age ______________

Father's job ______________________________
where?

____
what he does?

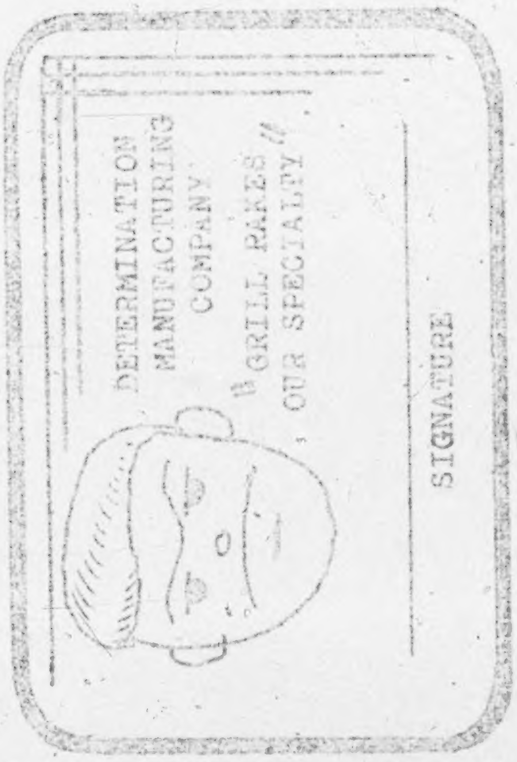
Education ______________________________
grade completed?

____
favorite school subjects?

Work experience ______________________________
summer camp?

____
church? boy's club?

____
Boy Scout's other?



DETERMINATION
MANUFACTURING
COMPANY

"GRILL PARTS"
OUR SPECIALTY

SIGNATURE

(cut out on solid line
and place in billfold)

____

Job wanted: ______________________________
describe the job.

____

Power tools ______________________________
power tools-have actually used.

____

Hand tools ______________________________
hand tools you have actually used

____

Can you read blueprints? ______________________________

Personal reference ______________________________
teacher

The above statements are true to the best of my

knowledge. SIGN HERE ______________________________

5:10

PERSONNEL DEPARTMENT

INTERVIEW FORM

Name ____________________ Date ____________________

Interviewer ____________________

INSTRUCTIONS: TALK to the person about each item on the application form. Ask the questions-how and where. Upon completion of the interview, circle the items below that best apply to the person just interviewed.

How does his appearance impress you?

poor careless neat

How well does he talk? Does he express himself:

poor very good really great

How sociable and friendly is he?

bashful somewhat friendly very friendly

How good is his reputation for work?

poor average good excellent

How much go ahead does he have?

none some plenty

How anxious is he to go to work?

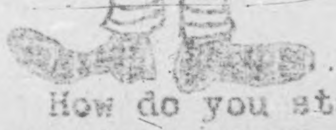
could care less not excited ready to go

How well do you think his experience fits the job?

no relationship some relationship great

Do you recommend hiring him for the job?

no yes



How do you stand?

JOB ANALYSIS

Your name ____________________

JOB ____________________
(exact title of the job)
____

OPERATION | **OPERATION STEPS**

1 ____________________

a ____________________
b ____________________
c ____________________
d ____________________
e ____________________

2 ____________________

a ____________________
b ____________________
c ____________________
d ____________________
e ____________________

3 ____________________

a ____________________
b ____________________
c ____________________
d ____________________
e ____________________

GOT EVERYTHING

HAZARDS: ____________________
what are they?
____
remedy?
____

CLOTHES: ____________________
TYPE
____
why?
____

PERSONNEL DEPARTMENT

EMPLOYEE RATING

Name__________________________________ Job________________________

Listed below are factors about a person and his job.

Circle the factor that best applies.

1. **QUALITY OF WORK**

a. aims to, get by
b. work is OK
c. is an accurate worker
d. does not always meet standards

2. **QUANTITY OF WORK**

a. slow to learn
b. has to be pushed
c. does a full period's work
d. meets requirements

3. **JOB ATTITUDE**

a. little job interest
b. wastes time
c. makes no effort to improve
d. co-operates with fellow workers
e. applies himself seriously to his work

4. **DEPENDABILITY**

a. is a safe worker
b. stays onthe job
c. does not waste time
d. usually on time
e. does not have to be "watched"
f. no UNEXCUSED absences

5. **INITIATIVE** (go ahead)

a. waits to be told what to do next
b. seldom plans work ahead
c. lacks interest
d. not working hard enough to get very far
e. needs CONSTANT supervision
f. keeps busy at his job
g. is nothing but a routine worker
h. refuses a better job
I. usually finds some way to solve a tough problem

6. **PERSONAL**

a. stirs up trouble
b. always talking bad about someone
c. visits too much
d. gets along well with other people
e. is a good steady worker
f. hates criticism
g. not orderly in his work
h. should be promoted

RATING check ✓	GOOD	FAIR	POOR
QUALITY			
QUANTITY			
JOB ATTITUDE			
DEPENDABILITY			
INITIATIVE			
PERSONAL			

"NEVER TOO LATE"

PRODUCTION

OBJECTIVES

The student, after studying this unit should learn:

1. The basic methods of drilling metals.
2. One of the basic ways to cut and bend metals.
3. How basic operations fit together in production to produce a output or product.

INTRODUCTION

A production operation is performed during the process of manufacturing a product. As such, it is only one of a series of things that must be done to produce the product. An example of this would be "drilling a hole or cutting metal with a hacksaw." These operations are only one part of making the total metal product. The manufacturing of different products may require different operations.

We will be studying the operations that have to be performed on the grill rake. By organizing these operations we can produce the grill rake cheaper and faster than by having one person make the complete product. Each operation will involve a different tool or machine. You will be concerned with the safe operation of these tools and machines. You will see that each boy assigned to a machine will operate it correctly and safely.

The three of you will be assigned as plant supervisors during the time of production. You will have to know how to do each operation and operate each machine that will be used in making the grill rake. For example, you will have to know how to cut the metal for the blade, and select the correct jig for drilling the holes in it. By going through the operations you will be able to help any worker who is having trouble doing his job.

DRILLING METALS

Drills and drilling devices are often used to drill holes in tapping for making screw threads, to assemble with rivets, and to make all types of cutout designs. We will be doing two drilling operations. The blade of the grill rake will be drilled on the drill press. The handle will be drilled with the electric hand drill. In setting up these drilling operations more time will be spent in organizing the operations and setting up the machines than in the actual drilling.

Drilling the blade

The speed at which a drill press should rotate varies with the diameter of the drill and kind of material being drilled. We will be using a hard metal, so we will need a slow speed. The speed will be determined ahead of time. The production operator will simply put the metal in the jig and drill the hole by feeding the drill into the jig holes.

Determining the proper feed, which is the amount of pressure applied when drilling, is a matter of experience.

Just enough pressure should be applied to produce chips. The operator will have to be especially careful as the point of the drill goes through the metal. Release the feed slightly. This is the time when the drill tends to catch and brake or spin the stock or jig around. (Fig. A).

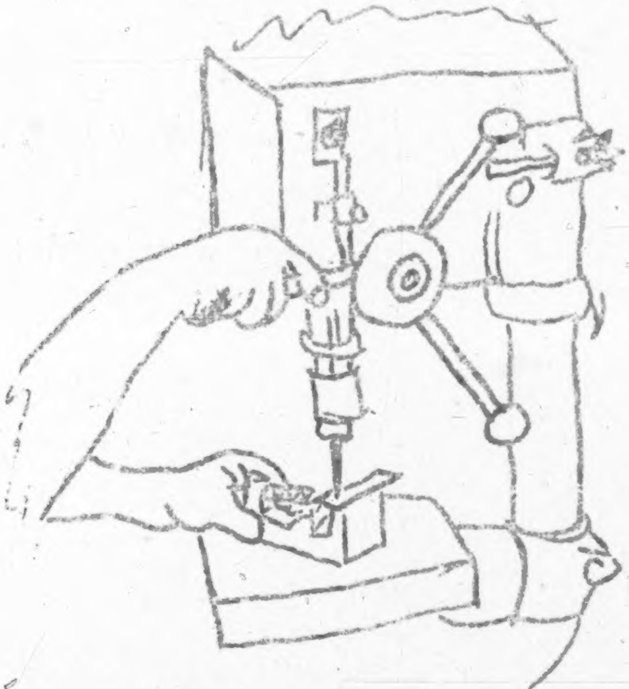


FIG. A. Drilling with the drill press.
Some workpieces are held with drill vises during the drilling operation.

Drilling the handle

It is extremely difficult to get the electric drill started correctly to drill the holes in the handle with the power turned on. Therefore, three steps must be taken. First, punch holes with center punch. Second, with the power turned off, place the point of the drill in the center-punch hole. Turn the drill chuck by hand, applying pressure to start the drill. Third, as you drill, guide the electric hand drill carefully, applying forward pressure with the right hand holding the drill back and steadying it with the left hand. It is especially easy to brake a drill since the slightest jerk will brake the drill. (Fig. B).

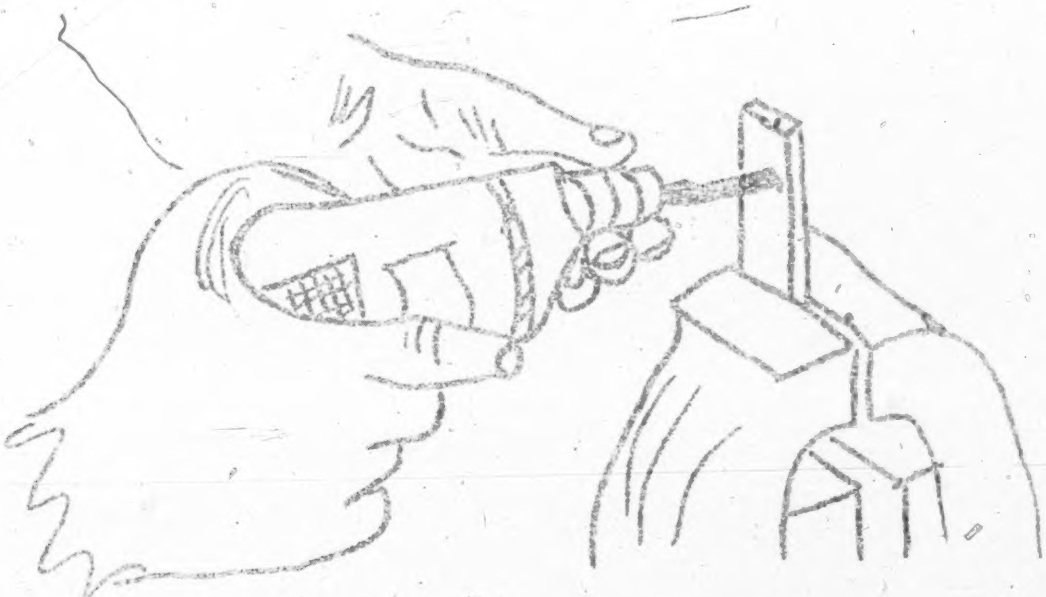


FIG. B. Starting the electric Drill. Rotate the chuck before turning on the power.

CUTTING THE METAL

The squaring shears will be used to cut the metal for the blade. The correct width has been pre-cut. The operator will have to cut it to the correct length. When cutting the metal for the blade, feed the metal in from the front of the shears against the back gauge. This gauge has been set to the desired length. Never attempt to cut band iron, wire, or any heavy metal on the squaring sheers.

Make sure that the right edge of the strip of metal is firmly pressed against the right gauge and the end of the strip is aganist the back gauge. Hold the strip down on the bed with both hands, and then apply pressure to the foot pedal with your right foot. (Fig. C). Keep your fingers away from the cutting blade at all times. Never allow anyone to be near the back of the cutting blade when you are cutting the metal.

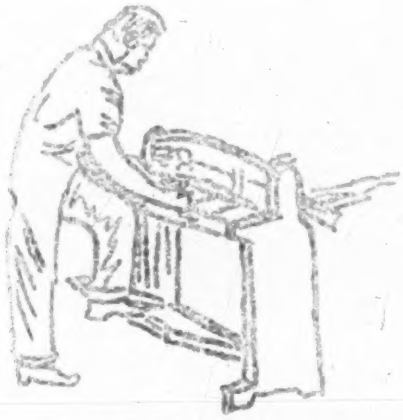


FIG. C. Cutting stock with squaring shears.

Cutting the handle

The handle will be cut with the hack saw. The metal is to heavy to cut it on the squaring shears. Start the cut by filing a notch. The cut should be started at a shallow angle off the edge of the stock. Never start against a sharp edge. Guide the blade with your thumb and begin with light pressure and a steady forward stroke. When the cut is started, use both hands to hold the frame. Apply steady downward pressure on the forward stroke, then release the pressure on the return stroke, and bring the saw back to the starting position. (Fig. D).

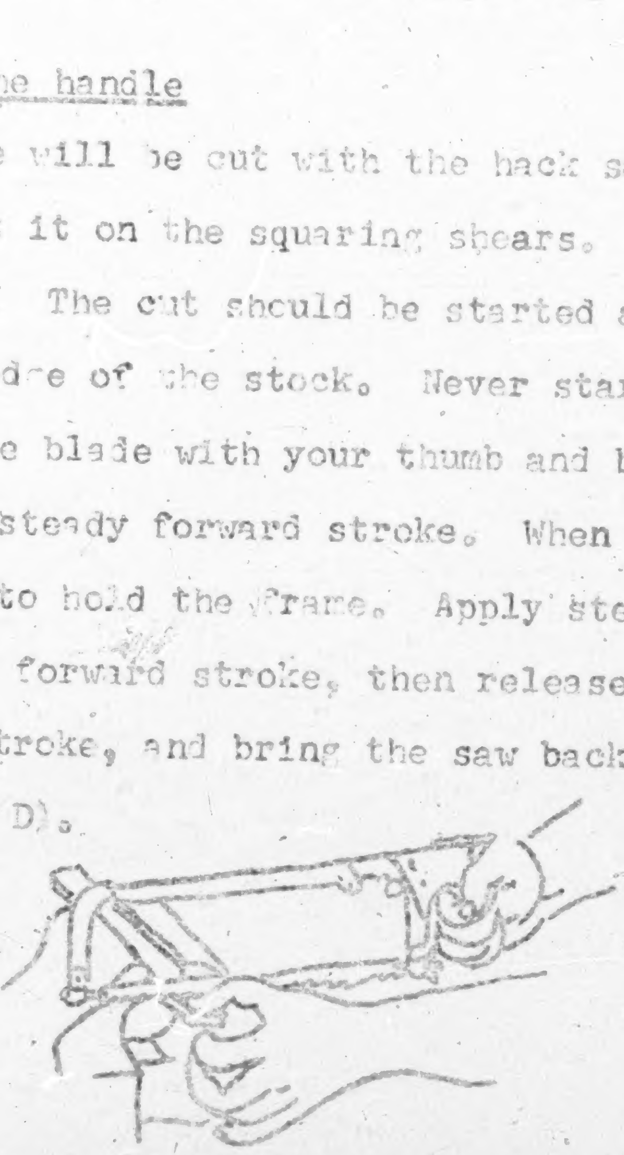


FIG. D. Starting cut with hacksaw.

BENDING THE BLADE

Metal can be bent by hand but if a box and pan brake is available, you can do a better job in much less time. In production the time element is a very important factor. For example, it is difficult to make a hem by hand, but on a box and pan brake it is extremely simple. We will be using the box and pan brake for bending the blade. The upper jaw of the box and pan brake is made up of a various widths of removable fingers. The metal is placed under these fingers to the desired length, and the handle is then raised to desired bending angle. We will bend the blade to a 90 degree angle. (Fig. E).

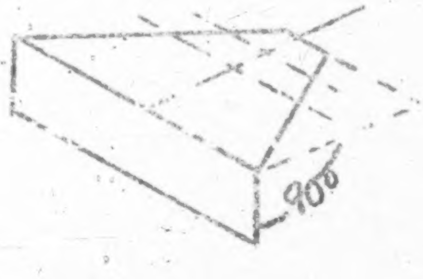


FIG. E. Bending: Bend on box and pan brake to desired angle (90 degrees).

Grinding the tang on the handle

This operation can be the most dangerious thing we do on the grill rake. Without the proper precautions, serious injury to the eye can occur. Make sure the operator is wearing goggles and the eye shield is in place on the grinder. Use only the face of the wheel, never the sides. The metal be held firmly on the rest and guide it back and forth to grind the straight edge. The work will get hot and burn (change color) during the grinding operation. Dip the handle in water to keep it cool. After the tang has been shaped clean the burrs off with a file.

Finishing the handle

The handle is the only part of the grill rake that will need finishing. Since, we will use pop rivets for assembling the blade and handle, the handle can be pre-finished. The handle will be sprayed with fast drying paint and allowed to dry about five minutes before assembly.

Assembly

Pop rivets will be used to assemble the blade and handle. Pop rivets will be used because of their speed, security, and neat appearence. The pointed stem of the rivet should be inserted into the riveting tool. The sleeve of the rivet portion is inserted into the drilled holes in the rake and handle. By pressing the handle of the riveting tool, the sten head will be drawn into the sleeve on the blind side of the blade. The stem head expands the sleeve to make the strong joint. (Fig. F).

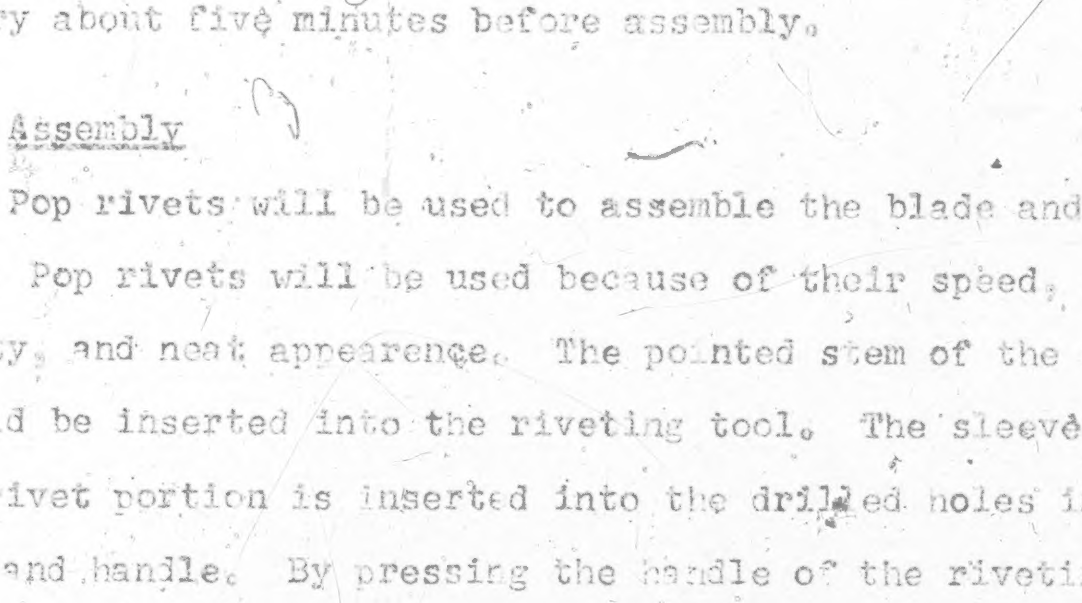


FIG. F. Making assembly with pop rivet; The sleeve on the rivet is expanded to form the joint.

SUMMARY

The grill rake is produced in three parts. The metal blade was cut and bent on the box and pan brake. The handle was cut with the hacksaw and the tang ground on the grinder. The holes were drilled on the drill press to enable the handle and blade to be pop riveted together. By organizing these mass production operations the class can manufacture this product in a very short period of time. The students assigned to these operations will have to do them correctly and safely.

ACTIVITY

Objectives

1. The student, from this activity should learn: The basic steps in making the grill rake.

You will go through the steps in producing the grill rake. You will need to have a good understanding of each operation. Because, doing the production your responsibility is to see that these operations are carried out correctly.

Materials

1. 1-piece of galvanize steel 4" by 4".
2. 1-piece of band iron 1/8" by 3/4" by 18".
3. 2- 1/8" by 1/4" steel pop rivets.
4. Spray paint

Equipment

1. Pop rivet set
2. File
3. Drilling jig
4. Tin snips

Equipment (cont')

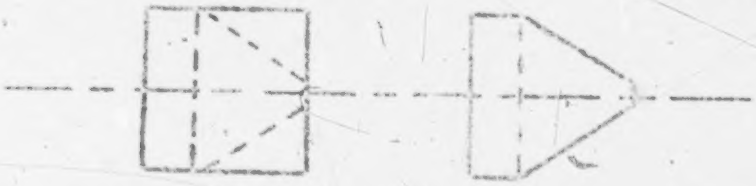
5. Squaring shears
6. Box and pan brake
7. Drill press
8. Electric hand drill
9. Hacksaw
10. Steel ruler

Procedures

1. Blade

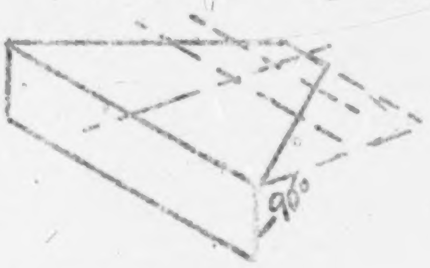
a. The sheet metal will be cut in strips 4" wide. By using the squaring shears, cut strip into 4" by 4" pieces.

b. Lay out angles and cut with tin snips.



c. Place sheet metal or blade into jig and drill holes. Deburr holes with file.

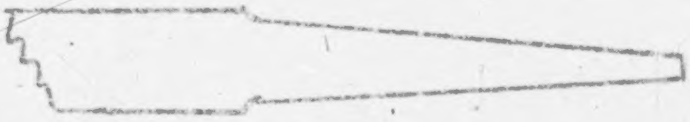
d. Bend blade to 90 degree angle.



2. Handle

a. Cut the band iron into 18" lengths.

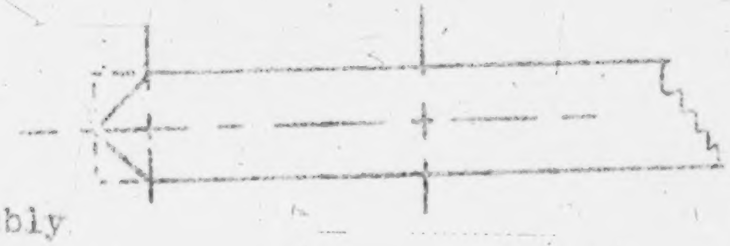
b. Lay out and cut tang with hack saw.



c. Place handle in jig and drill holes.

d. Deburr holes with files.

e. Grind the front of handle as shown below.



3. Assembly

a. Spray paint the handle before riveting.

b. Pop rivet blade and handle together.

SAFETY

OBJECTIVES

The student will be able to:

1. Recognize the importance of safety in industry.
2. Learn and follow good safety practices.
3. Learn safety hazards and how to avoid them.
4. Learn the safe operation of the following shop equipment; drill press, electric hand drill; grinder, box and pan brake, and squaring shear.

INTRODUCTION

In industry every year lost time is caused by on the job injuries. The total injuries add up to the loss of one full year's employment for one worker in every ten in America's industry. Also millions of dollars in income and production, medical expense and damaged equipment are lost. (Fig. A).

FIG. A. Safety! Lost time is caused by on the job injuries.

It was Friday afternoon in the junior high industrial arts shop. The class was busy in the mass production of grill rakes. (Fig. B).

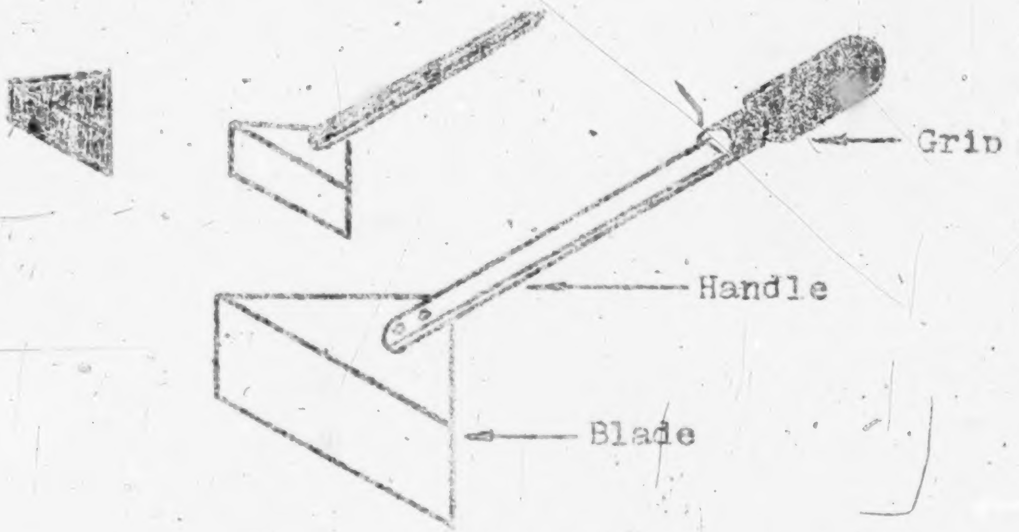


FIG. B. Grill Rakes. Mass Production of grill rakes in the industrial arts shop.

Bob was to be pitcher for his baseball team after school. He was in a hurry to finish the last sheet metal cut of the blade on the squaring shear. His teacher had told the class during a demonstration on the use of the squaring shear to never reach behind the shear and to keep feet clear of the foot pedal. (Fig. C). Bob was in a hurry. As he pressed down on the squaring shear foot pedal with his left foot, he forgot his right foot was underneath. The foot pedal came down on the right foot across Bob's toes. The school nurse looked at Bob's black and blue toes and told him to stay off his right foot for several days. This meant no baseball game and a painful foot besides.

What was wrong? For one thing, Bob wasn't following

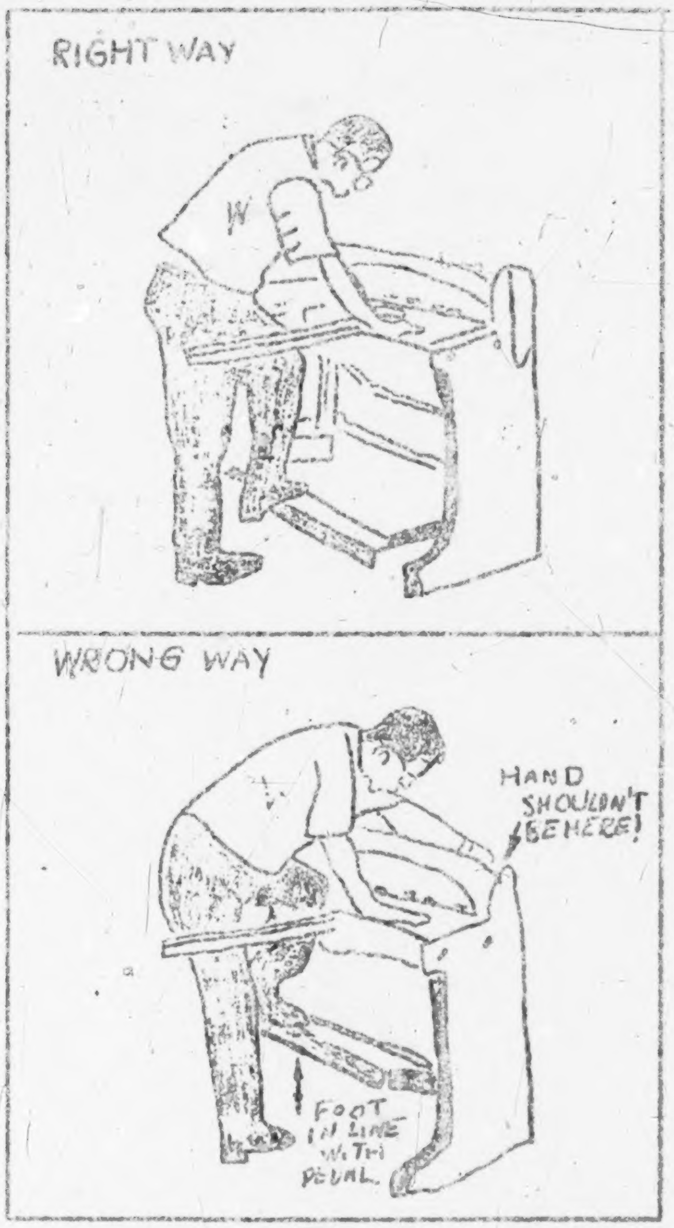

RIGHT WAY
W
WRONG WAY
HAND SHOULDN'T BE HERE!
FOOT IN LINE WITH PEDAL.

FIG. C. *Right* and *wrong* way to operate squaring shear. Never reach behind the shear and keep feet clear of the foot pedal.

good safety habits. He failed to practice two important lessons: *First*, that he must always follow directions. *Second*, that he must pay attention when operating a machine. Always watch your instructor as he demonstrates and follow instructions. Of course, everything you do has some danger to it; you can get hurt playing a game as well as working in the school shop. To keep yourself safe, you must learn the hazards and avoid them by following good safety practices while mass producing the grill rakes.

SAFETY PRACTICES

Here are some rules you must observe in mass production of grill rakes in the industrial arts shop. (Fig. D).

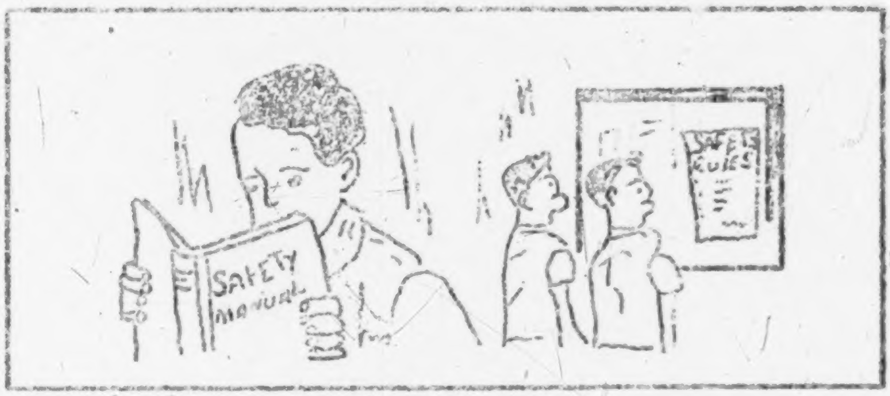


FIG. D Safety rules. Learn and follow good safety practices.

Always dress correctly for the job..

The standard dress in the shop is a protective apron. Also, eye protection is required. Therefore, always wear goggles or eye shields. (Fig. E).

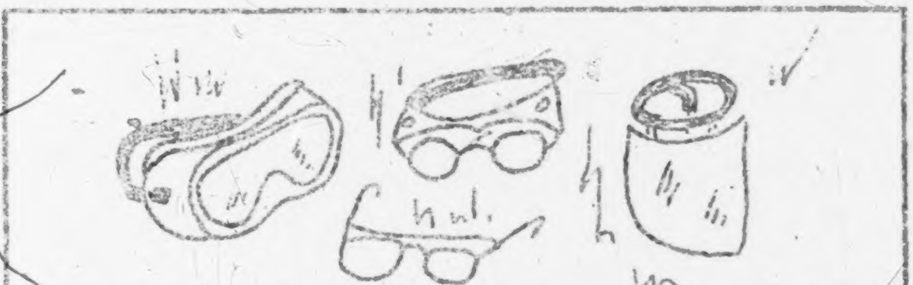


FIG. E. Goggles or eye shields. Always wear eye protection in the industrial arts shop.

Follow directions.

The A, B, C's of safety are ALWAYS BE CAREFUL. Never try to get by "just this once". That's usually the time an accident happens. A good slogan to follow is, "It is better to be safe than sorry".

Do your share in good shop housekeeping.

Don't "wait for George" to do it. A clean shop is a safer shop. Put your tools away after you have used them. Wipe up oil and grease spots. Keep rags in a metal container.

Avoid horseplay.

Practical jokes in the shop aren't funny. Would you like to cause a friend's accident? Wrestling, pushing, shoving, or tripping usually ends in an accident.

Report every accident no matter how small.

Get first aid for every cut or scratch. An infection can start from the smallest cut. Report every accident immediately to the safety engineer. The safety engineer will report to the instructor, and in turn the instructor will call the school nurse. The safety engineer must fill out a duplicate accident report and place a copy on file with the instructor. (Fig. F).

STUDENT ACCIDENT

REPORT FORM

Name of Student____________________________________Date________________

INSTRUCTIONS: TALK to the person injured & witnesses to the accident. Write out answers to the questions below. Give one copy to your instructor and keep one copy.

In this space please give as much information as possible about what you have learned about the accident.

Can you make a suggestion as to how the accident could have been prevented?

Safety Engineer's Name ______________________________

FIG. F. Student Accident Report Form

MACHINE SAFETY RULES

Drill Press

The drill press operator must observe the following safety rules in the mass production of grill rakes.

1. Know where the on & off switch and feed handle to operate the machine are located. Leave all other adjustments alone.
2. Permit the drill to stop of its own accord after the power has been turned off. Do not try to stop it with your hand.
3. Never use bare hands to remove chips from drill press table. Always use a brush.
4. Keep your head back and well away from any moving part of the drill press while operating.

Electric Hand Drill

The electric hand drill operator must observe the following safety rules in the mass production of grill rakes.

1. Check to see the drill bit is securely in the jaws of the chuck before doing any work.
2. Check to see the materials are firmly in jig & fixture before drilling holes.
3. Hold the hand drill with either hand, or with both hands, while drilling. Avoid forcing and breaking the drill bit.
4. Hold the hand drill until the switch is turned off and the motor has stopped. Then place it on a firm surface, such as a table.

Grinder

The grinder operator must observe the following safety rules in the mass production of grill rakes.

1. Grill rake handle should be fed slowly and gradually to avoid sudden pressures on the grinding wheel.

2. Do not adjust the tool rest while the machine is running. The tool rest should be approximately 1/8" from the face of the wheel. If adjustments need to be made, see instructor.

3. Always wear goggles while operating the grinder even though the machine is equipped with protective glass shields.

Box and Pan Brake

The box and pan brake operator must observe the following safety rules in the mass production of grill rakes.

1. Never place your hand under the dies of the blade.

2. If you are standing in front of the brake, stand back so that you will not be struck by the handle when it is swung up, bending the blade of the grill rake.

3. Do not bend any material other than the grill rake blade. Never bend rod or wire on any sheet metal brake. This will damage the blade by putting grooves in it.

4. Never pound on a sheet metal brake with any type of steel hammer. Always use a wood or plastic mallet. This also means that you should never use a steel hammer on sheet metal which is in the brake. This is because you may miss the metal and hit the brake, damaging it beyond repair.

Squaring Shear

The squaring shear operator must observe the following safety rules in the mass production of grill rakes.

1. Keep fingers clear of the blade and never under the hold down bar.

2. Never reach behind the shear to support metal. This places you in an awkward position, subject to a fall and puts your fingers in a blind area. To avoid crushing toes, keep feet clear of the foot pedal. (Fig. C).

3. Use care in handling sheared razor sharp metal on grill rake blade.

4. Never cut small pieces on a shear. Use hand snips.

5. The machine is a one man machine.

SUMMARY

Time is lost in industry every year by on the job injuries. One worker in ten losses one year's employment in America's industry.

1. The important safety practices are:
    1. Learn the shop safety rules.
    2. Learn safety hazards.
    3. Dress correctly.
    4. Follow directions.
    5. Good housekeeping.
    6. Avoid horseplay
    7. Report accidents.

2. The specific machine safety practices are:
    1. Drill Press
    2. Electric Hand Drill
    3. Grinder
    4. Box and Pan Brake
    5. Squaring Shear

LABORATORY ACTIVITY

Objectives

The student after reading the text should be able to:

1. Answer questions on the safe practices of working in the school shop.

2. Answer questions on specific machines.
    1. Drill Press
    2. Electric Hand Drill
    3. Grinder
    4. Box and Pan Brake
    5. Squaring Shear

Review Questions

Multiple choice: Choose best answer and place letter in blank.

_____1. It is poor practice to:

a. Place goggles in shop apron pocket.
b. Leave oil and grease spots on the floor.
c. Keep oily rags out in the open and not in a metal container.
d. All the above questions are correct.

_____2. Horseplay in the shop should be done:

a. When the instructor isn't watching.
b. All the time.
c. Sometimes.
d. Never.

_____3. If an accident should happen report it:

a. To a fellow student.
b. The next day if it still hurts.
c. Immediately to the safety engineer.
d. None of the above answers are correct.

_____4. Reaching behind the squaring shears to catch a piece of metal as it is cut is:

a. Permissible if the piece is three inches wide.
b. Permissible if the same person who reaches also operates the foot pedal.
c. Permissible if a and b are both followed exactly.
d. Dangerous at any time and it is a violation of safety rules.

_____5. Squaring shears can injure only the:

a. Hands.
B. Feet.
c. Either hands or feet or both.
d. None of the above answers are correct.

Matching: Choose the best answer and place letter in blank.

( ) Clean away chips with

( ) Never leave the machine

( ) Clamp or secure the

( ) Give the machine your

( ) Remove chuck key

( ) Always make sure the bit is

a. stock before cutting
b. a brush
c. machine is operating
d. the hand
e. full attention
f. before stopping the machine
g. mounted securely
h. loose for maximum freedom
i. turning on power

True & False: Use plus (+) for true, zero (0) for false.

( ) Use care in handling sheared metal because edges are razor sharp.

( ) Adjust the tool rest on the grinder while the machine is running.

( ) The clearance between the tool rest and wheel of grinder is approximately 1/8".

( ) It is not necessary to wear goggles while operating grinder as it is equipped with protective glass shields.

( ) When drilling with an electric hand drill it is important to keep your eyes and mind on the job being accomplished.

( ) It is good practice to hold or clamp materials firmly before drilling holes using an electric hand drill.

( ) Always disconnect the plug of electric hand drill before changing drill bits.

( ) Do not bend rod or wire on box and pan brake.

( ) Never use a wood mallet to pound on a box and pan brake.

( ) Never reach forward enough to permit fingers under the dies of the box and pan brake.

BIBLIOGRAPHY

Industrial Arts and Vocational Education Safety Manual, The Division of Safety and Hygiene, Industrial Commission of Ohio.

William A. Williams, Editor, Accident Prevention Manual For Shop Teachers, American Technical Society, Chicago, 1963.

COST CONTROLLING

OBJECTIVES

The student after studying this unit on cost controlling should be able to understand:

1. The economic reason behing manufacturing.
2. The important cost elements in manufacturing.
3. How a manufacturer decides a whole sale price.

INTRODUCTION

The principle reason behind manufacturing the grill rake is to make a profit. This is called the profit motive. To be successful a company must decide a price for its product that will return a fair profit. If the profit margin is too low the company will go broke. On the other hand if the price is too high the competitor will get all of the market.

In the manufacturing cost there are three items involved: (1) Raw Materials, (2) Direct Costs, and (3) Overhead Expenses. The following text will relate how the Determination Grill Rake Company decides its wholesale price based on the above three items.

RAW MATERIAL

The raw material of the grill rake consists of 24 gauge galvanized steel, 1/8" x 1/2" band iron, pop rivets, file handles and paint. (Fig. A).

24 gauge galvanized steel	$0.30 per sq. ft.
1/8" x 1/2" band iron	.06 per ft.
Pop rivets	.02 each
File handle	.10 each
Paint	10% of mat. cost

FIG. A. RAW MATERIAL COST: the price the company must pay for the raw materials necessary to manufacture the grill rake.

To determine the material costs of the grill rake, take the price of material used and divide the size of the part into the price unit. (Fig. B). This figure is important to know, but it is the smallest portion in the cost of manufacturing an item. It should be remembered that when buying raw material in larger quantity the price is lower. Of course, you should never over buy and have a lot of material left over.

Blade 4" x 4" = 16 sq. in. 16/144 = .11 sq. ft. material @.30 sq. ft. = .30/.11 =	.03
Handle = 18" long--material @.06 per ft. =	.09
Pop rivets (2) @.02 =	.04
File handle	.10
Paint (10% of raw material) =	.03
Total raw material cost	.29

FIG. B. RAW MATERIAL COST ANALYSIS: procedure for determining the cost of manufacturing one grill rake.

DIRECT COSTS

Direct labor cost is sometimes called direct costs. This would be a simple cost to figure if all workers were paid the same. This is not true. In the factory the more difficult jobs receive higher wages. This will require a system of keeping time by wage classification. (Fig. C).

Class A (vice presidents)	$0.60
Class B (supervisors and other officers	.50
Class C (workers)	.40

FIG. C. DIRECT LABOR COSTS: wage classification scale for employees.

Piece rates is another method of paying employees. It would be necessary to run a time study with this method. A time study is where a number of workers performs an operation a number of times and the average is computed. This would show how long an operation should take. The pay for the operation can be determined by dividing the time it took into an hourly rate. (Fig. D).

Name	No. of Time Study Cuts			Average
	1	2	3	
Bill	3.5	3.4	3.6	3.5
John	3.4	3.3	3.2	3.3
				6.8

Average time 3.4 minutes
Divide 3.4 into $0.40 per hour = .012 per operation

FIG. D. PIECE RATES: Time study of the grill rake handle operation determines average handle cutting time.

Labor costs is the most important factor in determining the price of the grill rake. To find the labor cost divide the total grill rakes made into the total cost of labor.

(Fig. E). When the cost of labor goes up so does the cost of the product. In the school shop the wages will be paid only on the two production days. Part of your grade will be determined by your work in the preproduction work. This makes it necessary to keep records of the preproduction time as well as the time of each worker on the job.

Labor is .50 average per day (estimate) =	$0.50
Production runs two days	x2 $1.00
Twenty students	x20 $20.00
Divide labor cost by number of products (grill rakes)	$20.00
Estimate 40 grill rakes in two production days	40 = $0.50

FIG. E. LABOR COST: The total labor costs divided by grill rake production determines the labor cost for each grill rake.

OVERHEAD

Overhead is all the indirect expenses not directly connected with raw material or direct labor costs. These are costs of heat, light, rent, depreciation on equipment, maintenance, and advertising. To compute the exact overhead costs would require a complicated cost accounting system. The government usually adds 40 percent of the direct cost to the item to cover the overhead expenses. We can use this method in the Determination Grill Rake Company. (Fig. F).

Raw Materials (Fig. B)	$0.29
Direct Costs (Fig. E)	.50
Overhead Costs (40% of direct costs)	.20
total manufacturing cost	$00.99

FIG. F. OVERHEAD: Forty percent of the raw materials and direct costs determine the overhead costs.

PROFIT

This is a very vital issue which the Determination Grill Rake Company must face. The profit must be high enough to pay all expenses but low enough to compete with other rivals in the field. The longer the production run the lower the margin of profit can be on each grill rake. For a short run the profit on each may be as high as 50 percent, while on a longer run it may be only 15 percent. (Fig. G).

Grill Rake manufacturing price	$0.99
Profit (15% of manufacturing price) ...	.15
Manufacturing wholesale price	$1.14

FIG. G. PROFIT: The cost analysis of Determination Grill Rake Company.

SUMMARY

The profit motive is the principle reason behind manufacturing the grill rake. To determine the manufacturing cost of the grill rake three things were considered: (1) Raw Materials, (2) Direct Costs, (3) Overhead Costs. The profit was listed at 15 percent of the manufacturing cost. The price of the grill rake was competitive with the rest of the products on the market.

LABORATORY ACTIVITIES

OBJECTIVES

1. To keep a record of all materials used.
2. To compare the actual raw material cost with the original raw material cost estimate.
3. To keep a time record of the students in the shop.
4. To see that the grill rake conforms to a set standard.

Activity #1 Material Estimate Sheet

The cost controller is to design a material estimate sheet and sent it to production department. The cost controller should ask the production supervisor to fill out the sheet and send it back at the end of the production run. (Fig. H).

Activity #2 Material Cost Comparison

At the end of the production run the number of products made will be divided into the total cost of the material. This will determine the actual raw material cost of the grill rake. This should be compared with the original raw material cost estimate.

Activity #3 Time Estimate Sheet

Part of the grade for this unit will be determined by the amount of time spent in the shop. Also, wages will be paid during the production periods of the shop. This will make it necessary to keep records of the students time. There will be a timekeeping form sent to each department.

The head of each department is responsible to see the time is entered correctly and sent to the cost controller. (Fig. I).

Activity #4 Quality Control

The principle reason in having a quality control inspector is to check to see if the parts fit. The inspector should check to see if the handle is 1/2" wide and 18" long, and that the blade is 4" x 4". His most critical function is to see that the rivet holes in the handle line up with the holes in the blade. His tools will be a measuring tape and a good eye.

COST CONTROL

MATERIAL ESTIMATE SHEET

DEPARTMENT ____________

MATERIALS DISCRIPTION	SIZE	UNIT COST	ITEM COST
		TOTAL COST	

8:8

FIG. H

8:9

COST CONTROL

TIME ESTIMATE SHEET

DEPARTMENT ____________

STUDENT NAME	JOB	TIME	DATE

FIG. I

FINAL EXAMINATION

Determination Grill Rake Co.

OBJECTIVES

1. To test the students understanding of the manufacturing process as it applies to the grill rake.

FINAL EXAMINATION

True - False. Mark a plus (+) for each true statement and a zero (0) for each false statement.

____ 1. The organizational chart of the D.G.R. Co. is most helpful in determining the cost of the product.

____ 2. The board of directors of the D.G.R. Co. is mostly concerned with the total operation of the company.

____ 3. The major parts of the grill rake are the blade, band and holder.

____ 4. The factor that most affects plant layout is the size of the product.

____ 5. A jig is used to hold the material and guide the cutting tool.

____ 6. Company hiring policy is decided upon by the company officers and personnel department.

____ 7. When drilling with the drill press, the most dangerous point of the operation is when the drill starts to go through the metal.

____ 8. If an accident should happen, report it immediately to a fellow worker.

____ 9. The principal duty of quality control is to see that the workers are on time.

____ 10. Assembly of the parts was done by using a tinners rivet.

Completion. Provide the word or words that will make each statement correct.

11. The structure of the D.G.R. Co. is such that the Design Department supervisor reports to the Vice President in charge of ______________.

12. The finish applied to the handle was put on by ________.

13. A good way to set up a production line is to think in terms of the __________________ of operations.

14. A ______________ holds and locates the work in relation to the cutting tool.

15. The ______________ forms contain facts about the person who wants the job.

16-17. Mass production is used in industry because a product can be produced ___________ and ___________.

18. To clean chips from the drill press table, use a ___________________.

19. The main reason for the manufacturer to produce a product is to _________________.

Multiple Choice. Select the answer that most nearly makes the statement correct. Place the letter in the blank.

____ 20. Which of the following characteristics is an important consideration in selecting all high level management officials:

A. Ability to get along with people
B. Skill in working with machine tools
C. Ability to make working drawings
D. None of the above

____ 21. The sub-element Planning, which we studied earlier, is used by:

A. Many people in D.G.R. Co.
B. Engineering Department only
C. Quality Control Department only
D. The Vice Presidents of D.G.R. Co. only

____ 22. Market research involves: (select two correct answers)

____

A. How much money people have
B. Find out what people might buy
C. Find out what people want
D. Find out how designers feel about a product

____ 23. Design is concerned with:

A. The outside of the product
B. The inside of the product
C. All of the above
D. None of the above

____ 24. The number of operation lines moving toward a single assembly line for completion of a product is determined by:

A. Total number of manufactured articles wanted
B. Amount of space available in the plant
C. Number of employees needed.
D. None of the above

____ 25. Manufacturing could be described as:

A. Input, processing, output
B. Raw materials, fabricating, shipping
C. Crude oil, refining, gasoline and by products
D. All of the above

____ 26. Pins in a jig:

A. Locate
B. Guide
C. Hold
D. Drill the workpiece

____ 27. Most bushings are made of:

A. Hard steel
B. Cast iron
C. Plastic
D. Aluminum

____ 28. The job analysis form tells:

A. The person how to get a job
B. The man to bring his lunch
C. The worker what he does on the job
D. The worker what he should not do on the job

____ 29. The reason people are interviewed is:

A. To see how nutty they are
B. To see if the person would make a good employee
C. To see if the person can talk
D. To see if the person has the right attitude

____ 30. When sawing with the hacksaw, always start the cut:

A. With a shallow angle to the edge
B. Against the sharp edge
C. With a backward stroke
D. None of the above

____ 31. Using the pop rivet:

A. Saves time
B. Allows a product to be finished before assembly.
C. Gives the product a neat appearance
D. All of the above

____ 32. It is poor practice to:

A. Place goggles in shop apron pocket
B. Leave oil and grease spots on the floor
C. Keep oily rags out in the open and not in a metal container
D. All the above statements

____ 33. Horseplay in the shop should be done:

A. When the instructor isn't watching
B. All the time
C. Sometimes
D. Never

____ 34. Reaching behind the squaring shears to catch a piece of metal as it is cut is:

A. Permissible if the piece is three inches wide
B. Permissible if the same person who reaches also operates the foot pedal
C. Dangerous at any time and it is a violation of safety rules
D. Permissible if A and B are both followed exactly

____ 35. What are the important cost elements in manufacturing: (one wrong)

A. Raw materials
B. Direct labor cost
C. Overhead
D. Transportation of labor

____ 36. What are the elements in overhead costs: (one wrong)

A. Lights
B. Wages
C. Rent
D. Heat

NOTES TO THE TEACHER

INTRODUCTION

The teacher should keep several things in mind when reviewing this material.

1. This synthesis project is an effort to tie together the elements of manufacturing (Part I of this series) studied previously. It is the consensus of this group that there is a logical transition which must be made for the student if he is to fully understand the meaning of the elements of manufacturing. This transition is the relationship of the Elements of Manufacturing to manufacturing organizations. The elements were studied as separate entities without regard for who performed them or when they were performed. Therefore, it is necessary to point out to the students the relationships which exist between this manufacturing company and the elements of manufacturing. The time to pay special attention to this aspect of the students learning is during the first two days of introduction. This relationship should be reinforced during the final board meeting.

2. The grill rake which is used as a product is only a vehicle. Almost any product could have been chosen and this model would have been valid.

3. The Critical Path Analysis is the key to the entire organization.
    a. This idea can be used with any product.
    b. It is flexible to the extent that you could use it with a product and a company being totally pre-designed. Or, you could present it to an advanced class as a concept of organization and allow them to work out the details. Or, you could pick any degree of complexity in between these two extremes.
    c. We have chosen a product and a company and have allowed the students to make one minor change in the design of the product. Therefore, we consider this to be a beginning experience in manufacturing.

ASSUMPTIONS

The following assumptions were made as this synthesis project developed.

1. One of the most desirable ways of relating the various elements of manufacturing is to establish a manufacturing company in the class room.

2. Time: 12-15 class periods of 50 minutes each.

3. 20-24 students per class period.

4. Students are able to read simple working drawings and have a knowledge of sketching.

5. Students will be assigned to jobs according to an established hiring policy.

6. Hiring policy must be such as to allow each student a variety of experiences.

7. Every student will not take part in every segment of the mass production activity.

8. Students will have a very limited experience with design change and how it affects jig and fixture design, job specifications and plant layout.

9.
9. Students not accounted for on days 6, 7, 9, 10 11, and 12 are being interviewed and placed on production jobs.

10. Class members are all members of the board.

11. The teacher is President of the Board and Chief Executive Officer.

12. The teacher constructs jigs and fixtures except for those made necessary by the design change.

13. The teacher supplies job specification sheets for each job. Students make revisions as needed to accomodate design change.

14. Board of Directors elects Vice Presidents.

15. Each department maintains cost records (time and material) and reports to cost control department.

16. After lecture-demonstration on shop processes,

a Vice President of Safety and a Vice President of Quality Control are elected by the Board of Directors.

17. Text materials will be provided about each area for each student. Laboratory activities will be used only with the specific group assigned the duties covered by a particular text assignment.

18. The order in which students study the text assignments will be determined by the job he holds within the company. (This information could be included in his job specification sheet).

19. The shop is equipped with simple hand metalworking tools, a drill press, an electric hand drill, squaring shears, a box and pan brake, and a grinder.

DETAILS OF CRITICAL PATH ANALYSIS

1. The introduction is a very important part of this project. If properly handled an "atmosphere" of serious business will be created. Some suggestions which might help create this atmosphere are:

   a. Have a teaching aid (transparencies or wall chart) of the Organization Chart.

   b. Avoid prolonged discussions of the product. This can help give the management functions their proper emphasis.

   c. Emphasize the importance of the people who are selected to manage the firm. Vice Presidents should be leaders.

2. Board Meeting #1--After Vice Presidents are selected they should choose their "teams". At this time Job Specification Sheets are distributed to each of the students. Review these with students.

3. Set up room so that departments each have "office space". These spaces should be clearly identified.

4. Before Part II of the Laboratory Activity begins, the students in the design department should experiment with twisting band stock. (This will indicate to them what can and cannot be done with twisting.) This experience should be of

value to him when he begins his redesign activity. This experimentation should also suggest methods for the jig and fixture department and the production department.

5. Production schedules must be met. This may mean that overtime will be required. We suggest that the following policy be established. Anyone who does not show up for overtime will receive "time and a half" (1½ minutes the next evening for every minute worked by those who did show up).

6. Board Meeting #2

   a. Review of design change. Select one solution.

   b. Review progress of all departments. ARE WE ON SCHEDULE?

   c. Check with students to see if reading assignments are being done.

   d. Clarify how design change affects plant layout, jig and fixture design and personnel.

   e. Personnel forms should not be used as a measure of student popularity. Encourage seriousness in this respect.

7. Shop Processes Lecture

   a. General overview of shop procedure for this project.

   b. Introduction to machines, etc.

   c. Select Vice President of Safety and Vice President of Quality Control.

   d. Introduce notion of Quality Control.

   e. Assign reading on safety and announce safety test for 10th period.

   f. Moving of equipment should be discussed.

8. Safety Test

   Safety test should be administered by Vice President of Safety.

9. Board Meeting #3

   a. This board meeting should consist of a status report.

   b. Possibly some exchange of ideas will occur. These ideas should help all class members see the relationship of all the activities.

10. Pilot Run

   a. Make machine adjustments.

   b. Identify people not knowing their jobs and retrain.

   c. Correct bottle necks in production.

11. Board Meeting #4

   a. Review of Pilot Run.

   b. Locate problems and find solutions.

12 Board Meeting #5

   a. Review of first day of production.

   b. Determine if any problems exist.

13. Board Meeting #6

   a. Each department will give a final report.

   b. Review how all departments work together.

   c. Ask for suggestions.

   d. Final examination. The sample examination was devised to determine the students understanding of the processes involved in the manufacture of the grill rake. The test is by no means comprehensive. The areas of manufacturing processes are only partially evaluated. It is presented to indicate that it is one way of evaluating the student's' progress. It should be only a part of the students total evaluation. Each teacher will want to devise his own examination to meet his own particular needs.